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Review of the 1982 Texas Closure for the Shrimp Fishery Off Texas and Louisiana.

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SUMMARY

Brown shrimp production in statistical subareas 18-21 from June 1981-May 1982 amounted to 41.5 million pounds. Peak production occurred from July-Sept, which accounted for 74% (30.7 million pounds) of the total landings in that biological year. High catches and extremely good levels of relative abundance occurred off the Texas coast in July and August. The peak in CPUE of almost 2,400 pounds/day occurred in July but dropped to 1,400 pounds/day in August. Production of brown shrimp from Sept-Dec amounted to 14.1 million pounds with an average CPUE of around 650 pounds/day. In the Jan-Apr period, production amounted to only a half million pounds with the CPUE falling to an average of approximately 270 pounds/day.

The 10.5 million-pound brown shrimp catch in Louisiana offshore waters during the July-Aug 1981 period was much lower than in Texas waters. The CPUE averaged 863 pounds/day. The Sept-Dec Louisiana offshore catch amounted to 4.3 million pounds with an average CPUE of 654 pounds/day, similar to the CPUE in Texas offshore waters. The catch in Jan-Apr amounted to only 700 thousand pounds with an average CPUE of 308 pounds/day.

In comparing the catch, fishing effort and CPUE for offshore waters of Texas from Sept 1981-Apr 1982 were compared with those for the same period in the historical data set (1960-1979), and no significant differences were found. The major differences that made 1981 an outstandingly productive year were the very high catches and CPUEs that occurred in July and August.

Recruitment to the Texas brown shrimp fishery in 1982 appeared to be below average. We estimate an annual production from July 1982-June 1983 of about 21.5 million pounds with a range from 19 million to approximately 28 million pounds. Average offshore production from Texas waters for the past 22 years has been approximately 27 million pounds.

The catch off Texas in July-Aug 1982 amounted to 13.1 million pounds in 1982 compared to 25 million pounds in 1981. The average CPUE for this period was 922 pounds/day compared to almost 1,900 pounds/day in 1981. The July-Aug 1982 catch off Louisiana amounted to 5.1 million pounds with an average CPUE of 524 pounds/day, whereas the July-Aug 1981 catch was 10.5 million pounds with an average CPUE of 863 pounds/day. The July-Aug 1982 Texas offshore brown shrimp catch and CPUE were 2.6 and 1.8 times greater than the respective catch and CPUE off Louisiana. The difference in the offshore catches is assumed to be attributed to 1.6 times higher fishing effort off Texas. The higher CPUE off Texas may be attributed to more larger shrimp being present which may be due to the Texas closure management measure. The lower CPUE off Louisiana may be due to the Louisiana inshore and offshore fisheries in May and June.

Because of the almost 50% decrease in catch and CPUE in the July-Aug 1982 period compared to July-Aug 1981, we estimate that the shrimp biomass off Texas was approximately half the level encountered in 1981. The major difference in 1981 and 1982 shrimp distributions is that in 1981 shrimp were found in good quantities from the beach out to approximately 35 fathoms whereas in 1982, good concentrations of shrimp were found only inside 20 fathoms off the Texas coast.

The Louisiana inshore brown shrimp fishery produced aproximately 15.1 million pounds in 1982 compared with 15.2 million pounds in 1981, but the offshore fishery in 1982 produced only 13.3 million pounds in 1982 compared with 23.1 million pounds in 1981. The inshore catch was predominated by shrimp in the 116-count or larger size category. Texas inshore fisheries accounted for approximately 4 million pounds of brown shrimp in 1982 and 4.2 million pounds in 1981. The inshore catch in 1982 was predominated also by shrimp of 116-count or larger size.

The size composition of the 1982 offshore brown shrimp

catch in Texas waters was approximately the same as in 1981, dominated by the 31-40 count size category.

The 1982 production of brown shrimp in July-Aug from statistical subareas 18-21 was the same or greater than in 1973-1976 and 1978-1979. Greater production occurred in 1981, 1980, 1977 and 1972. We conclude that the 1982 season is either average or slightly below average compared to the brown shrimp fishery from 1960 to the present.

INTRODUCTION

The implementation of the Gulf of Mexico shrimp fishery management plan (FMP) in May 1981 permitted, for the first time, closure of the brown shrimp fishery from the coastline to 200 miles off the Texas coast and was in effect from 22 May to 15 July 1981. The Gulf of Mexico Fishery Management Council (GMFMC) agreed to continue the seasonal closure of the brown shrimp fishery off the Texas coast in 1982 and implemented the second closure from 25 May to 14 July.

The objectives of the Texas closure management measure are to increase the yield of shrimp and to eliminate waste by discard of undersized shrimp in the fishery conservation zone (FCZ). According to the FMP, shrimp yield would be increased by protecting shrimp from fishing during the period when they are predominantly small and are growing rapidly. Discards would be reduced by eliminating the count restriction in order to allow all shrimp caught to be landed.

The purpose of this report is to provide information to determine how well the objectives of the Texas closure regulations were achieved in 1981 and 1982. This report reviews and analyzes the characteristics of the Texas and Louisiana fisheries west of the Mississippi River and describes the catch, fishing effort, relative abundance and recruitment to the offshore fishery from June 1981-Aug 1982.

MATERIALS AND METHODS

Collection of detailed catch statistics describing the U.S. Gulf of Mexico shrimp fishery is available since 1956 and the procedures used to collect them are described by Klima (1980). The statistics compiled by the Southeast Fisheries Center (SEFC), Technical Information Management Services (TIMS), consisting of catch by statistical area (Fig 1), effort data (in 24 hrs of fishing, time expressed as days fished) and size composition of the catch were used to analyze the effects of the Texas closure. Only commercial catch statistics from areas west of the Mississippi River (statistical subareas 13-21) were examined.

Locations and amount of fishing effort expended in 24 hours fishing were obtained by interviewing fishing vessel captains at the termination of their trips. All catch data were recorded as heads off by species and size category, by statistical subarea, depth zone and month, and are reported in "Fishery Statistics of the United States (1956-1979)" and "Shrimp Landings (1956-1979)". Catch and effort data from 1980 to the present are on file at the SEFC/TIMS office where they are available for inspection by interested parties. These data were used to compute catch per unit effort (CPUE) per 24 hours of fishing. Number of shrimp caught were estimated by multiplying the pounds caught by the mid point of the size category, and in the case of ‹15 or ›116 count, 15 and 116 were used respectively. Starting in May 1982, TIMS started to record pounds caught in size categories smaller than 68 count as follows: 68-80, 81-100, 101-115 and 116 count or greater. Messrs. Orman Farley[1] and Orville Allen[2] provided specific information

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concerning the Texas and Louisiana inshore and offshore shrimp fisheries relative to fleet activities, changes in the fleet, number of trips, discards and specifics of catch and effort for the fishing area during 1982.

Catch data frequently follow skewed distributions, show heteroscedasticity and have non-additive components. Transformations applied to the original data are often able to alleviate these problems and permit valid statistical analyses of the data employing t-tests and 2-way analysis of variance (ANOVA) (Sokal and Rohlf, 1969). Taylor's (1961) test analyzing relationships between means and variances was applied to the brown shrimp catch data. It showed that catch data should be transformed to their logarithms, fishing effort data did not need to be transformed, and CPUE data should be transformed to their square roots. The analyses of these transformed data provided statistical support to what the untransformed data showed. The summaries are presented here with untransformed data.

Statistical Tests

The commercial catch data were grouped into biological years May-Apr, since brown shrimp are recruited to the fishery in May of each year. The first and last biological years identified are May 1960-Apr 1961 and May 1980-Apr 1981.

Mean monthly catch, mean monthly fishing effort and mean CPUEs for the 1960-1979* period were compared with the May 1981-Apr 1982 monthly data via 2-way ANOVA using paired observations.

Additional comparisons between the May-Aug monthly means of the fisheries data for statistical subareas 13-17 and 18-21 for the entire time series 1960-1979 and the five latest years (1975-1979)* were compared with the 1982 monthly data from May-Aug, using paired observations in a 2-way ANOVA and in t-tests. The shrimp size distributions for each month were compared with the historical

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*Does not include 1980 data because this data file has not been verified at this time.

data set 1960-1979 and 1981 and 1982 monthly size distributions by visual inspection. Unless otherwise stated, tests of significance were performed at the 95% level (P = 0.05) (Sokal and Rohlf, 1969).

RESULTS

1981 Texas Closure

Klima et al., (1982) reported on the 1981 closure for the months of July and August and showed that the catch, fishing effort and CPUE off the Texas coast (statistical subareas 18-21) were significantly greater than the catch off Louisiana during the same period, and they were significantly greater than in the historical data for Texas. Information is now available on the catch, fishing effort and CPUE from Sept 1981-Apr 1982 for both Texas and Louisiana. These data have been analyzed by 2-way ANOVA, and the results indicate that the catches in Texas and Louisiana offshore waters during this time frame were not significantly different overall, but that differences among months were significant (Figs 2a and 3a, Table 1).

Comparison of the fishery effort information between Louisiana and Texas showed a significant difference between fishing efforts in the two areas, but no significant difference among the months (Figs 2b, 3b; Table 2). Results also showed no significant differences in mean relative abundances (CPUEs) between Texas and Louisiana, but did show significant differences among months (Figs 2c, 3c; Table 3). We have also compared the catch, fishing effort and CPUE for each month from Sept 1981-Apr 1982 with the means from the historical catch, effort and CPUE from 1960-1979 for the same months for the Texas coast (statistical subareas 18-21). Results of t-tests revealed no significant differences between recent and historical catches, effort or CPUE (Figs 4a, b, c; Tables 4 and 5).

*Does not include 1980 data.

We also examined the differences in the catch, fishing effort and CPUE from Sept 1981-Apr 1982 with the means for the same months from Sept 1975-Dec 1979. This comparison was made because there may have been some slight changes in the fishery patterns in the last five years compared to the historical 20-year data set. Results of t-tests in the catch, fishing effort and CPUE showed no significant differences (Table 6). We have already noted in previous reports (Klima et al., 1982) that fishing effort has decreased slightly from January-April in the last few years.

1982 TEXAS CLOSURE

In 1982, the FCZ of the United States and the territorial sea of the State of Texas were closed to all shrimp fishing from 25 May-14 July. A daytime fishery from the beach to 4 fathoms was permitted along the entire coast during this period. The total landed catch in June for the daytime fishery was approximately 47,000 lbs for brown shrimp and 147,000 lbs for white shrimp. The July white shrimp catch was 232 thousand pounds with the majority being produced in statistical subareas 18-19.

Enforcement

In 1982, only three vessels were recorded as violating the Texas closure regulations. Charles Fuss[3] indicated a 98% compliance with the regulations. Compliance is estimated from observations made during the entire closure period of vessels complying or not with the regulations and this is an average of all observations made during the entire closed period. Therefore, in 1982 there was a high rate of compliance with the Texas closure, and the shrimp in the closed area were effectively protected from fishing.

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[3]U.S. Department of Commerce, NOAA, NMFS, Enforcement Office, 9450 Koger Blvd., St. Petersburg, FL 33702

Recruitment

Estimates of the potential yield from the spring 1981 brown shrimp crop were made by the Texas Parks and Wildlife Department (TPWD) and the National Marine Fisheries Service (NMFS). Both estimates indicated that the 1981 crop was projected to be slightly better than average (Klima et al., 1982). We (NMFS) estimated a yield of approximately 29 million pounds (±2.7 million pounds at the 95% confidence level); however, more than 40 million pounds of brown shrimp were caught off Texas waters from July 1981-May 1982. The difference in the projected estimates and actual higher catch was attributed to the Texas closure (Klima et al., 1982).

Recruitment to Texas offshore waters in 1982 also was estimated by the TPWD and the NMFS. Bag seine data collected by TPWD indicated that the yield in 1982 would be similar to that observed in 1981[4] (Table 7). The bag seine data showed little difference in the Apr-July catches from between 1981 and 1982. In comparisons with previous years, however, the April 1982 catches were significantly greater than catches from 1978-1980. Bag seine catch rates between 1978-1982 appeared to be similar, with very little differences. Therefore, Mr. Bryan[4] concluded that 1982 would be similar to 1981.

The bait shrimp model developed by (Klima et al., 1982) predicted that the 1982 yield would be poor compared to 1981 (Fig 5). It predicted a catch of approximately 21.6 million pounds (± 2.8 million pounds at the 95% confidence level) from July 1982-June 1983. Obviously the NMFS and TPWD indices do not agree. The bait shrimp model has a relatively high degree of correlation with landings for data covering the past several years. We support the

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[4]Bryan, C. E., personal communication; Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, TX 78744

indices' indication that recruitment from Texas bays in 1982 was significantly less than that observed in 1981.

Another indicator of recruitment is the offshore catch in July and Aug. The offshore catch in July-Aug 1982 from statistical subareas 18-21 amounted to 13.1 million pounds. Historically, the July and August brown shrimp catch averages 47% of the total production from July-June of each year. The average annual yield from this area since 1960 has been about 27 million pounds. Therefore, since the July-Aug 1982 production was 13.1 million pounds, the total production for the year from July 1982-June 1983 should be about 27.7 million pounds, or approximately 3.3 million pounds greater than the upper confidence limit of the bait shrimp index.

Using these two methods, our best estimate of brown shrimp production for July 1982-June 1983 is between 19 and 28 million pounds, which indicates less than average recruitment in 1982.

Discards

Farley[1] indicated that no major culling of juvenile brown shrimp occurred immediately after the season's opening on 14 July 1982 except 1) usual culling of from 1-10 pounds of shrimp per drag encountered by all vessels during most of the year, and 2) scattered discards of shrimp when drags contained several hundred pounds of small fish and few shrimp. Farley indicated that culling before 1982 was dependent upon size count laws and the absence of markets for small shrimp. He further indicated that in 1982, there was a market for small shrimp and that quite heavy landings of 60-count and smaller shrimp were landed during the last two weeks in July.

Allen[2] indicated that vessels operating out of Louisiana, Mississippi and Alabama did not discard large quantities of small shrimp, but that several reports were made of discarding small quantities of shrimp due to heavy trash encountered off western Louisiana and in one instance off Freeport, Texas. It appears that low discarding of small shrimp was encountered during the 1982 season.

INSHORE FISHERIES

Inshore shrimp fisheries of Texas and Louisiana are managed by the respective states. Specific regulations concerning fishing activities are in force for both states, limiting the time of fishing during the day, size of fishing gear, fishing areas and seasons.

Louisiana

The inshore Louisiana brown shrimp fishery averaged 10.7 million pounds ± 4.1 million pounds standard deviation from 1960-1981 (Fig 6). Peak production in Louisiana appears to be cyclic in that low production was observed from 1960-1966 and above average production except in 1973-1975 and 1980. Historically, the Louisiana inshore fishery is concentrated from May-Aug, with peak production in May and June.

In 1982, May production was 6.6 million pounds and June production was 6.9 million pounds, dropping to slightly more than 1.5 million pounds by July (Fig 7). The size composition of the Louisiana catch in 1981 during the peak months was predominated by 68-count shrimp or smaller. In 1982, TIMS agents collected specific size information of shrimp smaller than 68-count; the May-August 1982 data revealed that the size composition in Louisiana was predominately the 116-count or smaller (Table 8) size group. The May-August 1982 catch in Louisiana for inshore waters amounted to 15.1 million pounds, with peak production in May and June.

Texas

Landings for the inshore brown shrimp fishery for Texas have been increasing for the past several years. The average catch over the 22-year period (1960-1981) is 1.8 million pounds ± 1.3 million pounds standard deviation (Fig 8). The landings in 1979, 1980 and 1981 were 4.1, 4.7 and 4.2 million pounds, respectively. This is significantly above the 22-year average.

The inshore brown shrimp fishery takes place from late Apr-Aug. Peak production in Texas waters occurs in June of each

year. Specifically, the catch in 1982 peaked in June, with a production of about 2 million pounds compared with 1.1 million pounds in May (Fig 9). The size composition of the inshore catch from May-Aug is predominated by 68-count shrimp or smaller. In 1982, TIMS statistical agents collected information on the specific size categories of shrimp smaller than 68-count. These data indicate that the catch was composed primarily of 116-count shrimp or smaller in May and June (Table 9). The total inshore catch for Texas in 1982 was 4.1 million pounds.

Size Distribution

The inshore size distribution of brown shrimp caught in Louisiana and Texas is remarkably the same from May-Aug. Generally, the average size in May was about 110-count/pound in both states, whereas in June the average count in Texas was about 106 and in Louisiana about 94. In July, the average size count dropped to approximately 75-89 count shrimp in both states and by August, when the fishery drops drastically, the average size count dropped to less than 85-count shrimp in Texas and 64-count shrimp in Louisiana (Figs 10a, 10b).

OFFSHORE FISHERIES

Louisiana

In May 1982, the fishery off Louisiana produced 3.3 million pounds of brown shrimp and occurred primarily in the shallow waters of statistical subareas 13 and 15. Little production was realized from other zones (Figs 11, 12). Fishing effort was relatively high off Louisiana (5.4 thousand days) but the CPUE averaged only 609/pounds/day. Highest CPUE was recorded off statistical subareas 13 and 15, with low CPUEs in other statistical subareas.

In June, the fishery off Louisiana produced 5.3 million pounds of brown shrimp with a fishing effort of 8.8 thousand days and average CPUE of 604 pounds/day. The highest CPUE was recorded

off statistical subarea 14 but there was little difference between statistical subareas 15-17 (Figs 11, 13). During June, Texas vessels did not fish off the Texas coast for brown shrimp but primarily concentrated their activities in western Louisiana. Approximately 1 million pounds of brown shrimp were landed by vessels which returned to Texas ports. In addition to the brown shrimp, the Texas fleet also caught 189 thousand pounds of white shrimp off the beaches of Louisiana. A total of 978 trips were recorded for Texas vessels fishing in Louisiana waters. Over 80% of the brown shrimp were caught in statistical subareas 16-17, primarily between the 6-20 fathom depth zones.

The July fishery in statistical subareas 13-17 produced 3.3 million pounds of brown shrimp with 6.4 thousand fishing days. Relative abundance averaged 525 pounds/day fished, with the highest CPUE observed off statistical subarea 14 (approximately 990 pounds/day fished) (Fig 14) and the lowest CPUE (449 pounds/day fished) in statistical subarea 17. The maximum production occurred inside of 10 fathoms.

In August, the Louisiana offshore fishery produced approximately 1.8 million pounds of brown shrimp with an average CPUE of 522 pounds/day. Little difference was observed in the amount caught, fishing effort and CPUE between statistical subareas (Fig 15).

Texas

The May fishery off the Texas coast was concentrated on brown shrimp in which 768 thousand pounds were landed. The predominant modal group was 31-40s and only 73 thousand pounds of small shrimp (68-count or smaller) were landed. In addition to the brown shrimp fishery, almost a half million pounds of white shrimp were landed. Major brown shrimp fishing zones were in statistical subareas 20-21, which produced over 86% of the catch (Fig 16). The white shrimp fishery was located primarily in statistical subareas 18-19, which produced over 66% of the catch.

No fishing for brown shrimp was permitted from 25 May to 14 July and all fishing in waters off Texas was concentrated on white shrimp. June production of white shrimp amounted to about 147 thousand pounds, caught mainly from statistical subareas 18-19 within 5 fathoms. The CPUE averaged 313 pounds/day. Associated with the white shrimp catch was a catch of slightly over 47 thousand pounds of brown shrimp, primarily smaller than 68-count.

With the opening of the brown shrimp season in mid-July, production occurred in statistical subareas 18-21. The fishery produced 6.6 million pounds of brown shrimp with 5.2 thousand days of effort with an average CPUE of approximately 1,300 pounds/day. Highest CPUE (1,550 lbs/day) was observed in statistical subareas 20-21 (Fig 14). Peak production came from the 11-15 fathom depth zones in statistical subareas 19-21 (Fig 16).

In August, the Texas catch amounted to 6.4 million pounds, with fishing effort increasing to 10.2 thousand days. CPUE averaged 629 pounds/day, ranging only slightly from a high of 687 pounds/day in statistical subarea 19 to a low of 512 pounds/day in statistical subarea 21 (Fig 16). The August peak production occurred in the 11-15 fathom depth zone in statistical subarea 19 (Fig 16). High production also occurred in statistical subarea 18 from 6-25 fathoms. Limited production was observed in statistical subareas 20-21 from 11 fathoms seaward.

A comparison of the July catch between 1981 and 1982 indicates a similar fishing pattern except fewer brown shrimp were caught in waters deeper than 16 fathoms in 1982 compared to 1981. August 1981 and 1982 production appeared to be similar in statistical subarea 18 but was drastically different in statistical subareas 19-21, as lower production was realized in these three areas because smaller quantities of shrimp were caught seaward of 16 fathoms in 1982 compared to 1981. The data indicate that in 1981 there were large quantities of shrimp out to 35 fathoms. This does not appear to be the case in 1982, as only small quantities of

shrimp were found seaward of 16 fathoms along the Texas coast in July and August.

There did not appear to be any detectable difference in the catch, effort and CPUE observed in July and August 1982 compared to the historical data set from 1960-1979 (Table 10). In addition, we compared the catch, fishing effort and CPUE during July and August 1982 to the historical data set from 1975-1979. Again, there was no detectable difference in these three important fishing parameters (Table 11). In comparing the catch, fishing effort and CPUE between 1981 (July-Aug) and 1982 for statistical subareas 18-21, it is obvious there were large differences; namely, the 1981 CPUE was more than doubled that in 1982. Fishing effort was 600 days less in July 1981 than July 1982, but the fishing effort was almost identical in August in the two years.

The resultant catch from the 1981 fishing effort was far greater than that observed in 1982: 24.9 million pounds versus 13.1 million pounds. There is no question that the fishery in 1981 produced more shrimp from the Texas coast than it did in 1982. Relative abundance was far greater in 1981 than 1982, resulting in record production in 1981 and only average production in 1982.

Size Distribution - Commercial Catch

The size composition (measured by the number of shrimp/lb) of the 1982 commercial offshore catch of brown shrimp from statistical subareas 13-17 from May-Aug 1982 was dominated by 68-count and smaller shrimp in May, June and July (Fig 17). In August, the catch was uniformly distributed between the 26-30s to 68-count shrimp. The average number of brown shrimp/pound caught in statistical subareas 13-17 in Louisiana from May-Aug decreased from about 65-count to approximately 46-count and little or no difference was observed between 1981 and 1982 (Fig 19).

The size distribution for the catch of brown shrimp from statistical subareas 18-21 from May-Aug 1982 was significantly different than that observed off Louisiana. In May, the catch was

composed of nearly equal amounts of all size categories recorded, whereas in June only a small amount of shrimp (47,000 lbs) were landed off the Texas coast in conjunction with the white shrimp fishery and these shrimp were 68-count or smaller. In July, the 31-40 count was the predominant modal group, as it was in August (Fig 18). The 31-40 size class was the dominant modal group of brown shrimp caught in July-Aug 1981 off Texas (Klima et al., 1982. No difference was observed between the May, July and August 1981 and 1982 average number/pound of shrimp caught off Texas (Fig 19). There appeared to be some difference in the average number/pound between June 1981 and June 1982; however, the catch was extremely small and amounted to less than 1% of the total catch of brown shrimp in the Gulf of Mexico in June.

In 1982, TIMS agents began to collect shrimp size in categories smaller than 68-count. These data show that, in western Louisiana, the average size count for the offshore fishery was 95 in May, 71 in June, 62 in July and 46 in August whereas for the Texas coast, the average size count was 36 in May, 72 in June, 41 in July and 36 in August (Fig 20). It appears that the greatest differences in the size composition between Texas and Louisiana occurred in the May, July and August catches.

In addition to describing the pounds landed by size count, we have converted the size category into numbers of shrimp caught in Texas and Louisiana, both for offshore and inshore waters. Large numbers of shrimp were caught in Louisiana inshore waters in May and June but the catch decreased drastically in July and August (Fig 21). The Louisiana inshore and offshore fisheries caught about a billion shrimp in both May and June, with the catch dropping to slightly less than 300 million in July and less than 70 million in August. Less than 160 million shrimp were caught in Texas waters in May and June 1982; however, the production increased to approximately 316 million and 456 million in July and August, respectively (Fig 22). In comparing the two states and the

total number of shrimp landed, it is evident that in 1982 Louisiana produced more shrimp in numbers than did Texas (2.4 billion versus 1.1 billion, respectively) (Fig 23). However, total production in Texas was 17.7 million pounds compared to 30.1 million pounds in Louisiana for the May-Aug period. Texas and Louisiana offshore production during this period was almost identical (13.7 and 13.3 million pounds, respectively). Louisiana inshore waters produced 15.1 million pounds whereas Texas only produced 4.0 million pounds, which accounts for the large difference in total catch between these two areas.

DISCUSSION

1981 Fishery

The peak Texas offshore brown shrimp catch occurs from July-Sept of each year and comprises approximately 65% of the total catch from July-June of consecutive years. In 1981, the fishery peaked in July-Sept and 30.7 million pounds were landed, or 74% of the total production from July 1981-June 1982. The fishing effort expended in the fall of 1981 remained at a relatively high level, i.e., 6,000 days, until November and December, when it dropped to about 4,000 days/month. From Jan-Apr 1982, fishing effort was less than 1,000 days/month. The CPUE (or relative abundance) dropped in September 1981 to 929 lbs/24-hrs and thereafter declined each month to a low of about 300 lbs/24-hrs from Feb-Apr 1982.

The catch in offshore Louisiana waters was extremely low from Sept 1981-Apr 1982, with less than a half million pounds landed per month from Jan-Apr 1982. Likewise, effort was extremely low during this period. The CPUE remained more or less constant from Sept 1981-Apr 1982, ranging around 600 lbs/24-hr day from Sept-Dec 1981 and decreasing from 500 to 280 pounds/24-hr day from January-April 1982. There was no difference observed in the catch and CPUE between Louisiana and Texas from Sept 1981-Apr 1982.

In comparing the offshore waters of Texas from Sept 1981-Apr 1982, there was no detectable difference in the catch, fishing effort and CPUE compared to the historical data set from 1960-1979. The main differences in the 1981 fishery were observed in July and August, when peak brown shrimp production occurred off Texas.

1982 Fishery

In 1982, recruitment from Texas bays to offshore waters of Texas appeared to be lower than in 1981, with an estimated projected catch from July 1981-June 1982 of only about 21.5 million

pounds, using the NMFS recruitment model. Production from July 1981-June 1982 amounted to slightly more than 40 million pounds. Therefore, recruitment to the 1982 fishery appears to be about half the 1981 recruitment level. The 1982 catch and CPUE in Texas offshore waters in July and August were at least half that observed in 1981. Average CPUE was 1,279 and 629 pounds/day for July and August 1982, respectively. The combined catch for July and August was 25.0 and 13.1 in 1981 and 1982, respectively. The brown shrimp catch in offshore waters in western Louisiana in July and August 1982 was also considerably below that observed in July and August 1981. Total production from Louisiana waters for these two months amounted to only 5.1 million pounds, whereas in July and August 1981 it amounted to 10.5 million pounds. The CPUE was about 40% lower in 1982 than in 1981, (i.e., 524 pounds/day in 1982 and 863 pounds/day in 1981).

In comparing the May-Aug catch data for the last five years (1978-1982), it appears that the 1982 Texas production is equal to production in 1980 and similar to that of 1978 (Table 12). Offshore production for the May-Aug period ranged from 10.1 million pounds in 1979 to a high of 25.3 million pounds in 1981. Louisiana offshore production during the same period ranged from a low of 11.7 million pounds in 1980 to a high of 23.1 million pounds in 1981. Offshore production was 13.9 million pounds in 1982, almost half the 1981 production.

The offshore production in both Louisiana and Texas in 1982 amounted to only about 55% of the offshore production realized in 1981. In 1981 and 1982, a large difference was observed in the offshore July-Aug production and CPUE between Louisiana and Texas, in fact, the July-Aug 1982 brown shrimp catch and CPUE from statistical subareas 18-21 was 2.6 and 1.8 times greater than the respective catch and CPUE from statistical subareas 13-17. The increase in catch off Texas is partially attributed to 1.6 times greater fishing effort off Texas and also to a higher level of

abundance. We assume that the 1982 brown shrimp offshore recruitment was similar between western Louisiana and Texas; however, the offshore relative abundance of the brown shrimp stock was not similar between these two areas. The July-Aug higher level of relative abundance off Texas as compared to western Louisiana may be attributed to the Texas closure measurement measure, which prevented harvesting brown shrimp from 25 May to 14 July.

Major differences between Texas and Louisiana occurred in the inshore production, since Louisiana produced 15.1 million pounds in 1982 and 15.2 million pounds in 1981, whereas Texas inshore production was around 4 million pounds in both years.

The size distribution of the offshore catch in Texas was approximately the same as in 1981 and was dominated by the 31-40 count size category. Texas inshore catch was predominantly smaller than 116-count size. Size distribution of the catch in Louisiana was dominated by extremely small shrimp ranging in average size from 95-count down to 62-count from May-July, whereas the Texas catch averaged between 36- and 41-count for offshore production in May and July. Inshore production in Louisiana centered on extremely large quantities of small shrimp which averaged 107-count in May and decreased to 74-count by July. Both states caught small shrimp; however, Louisiana's inshore production was four times greater than that of Texas.

The preponderance of small shrimp landed in inshore Louisiana waters, as well as Texas waters, obviously will result in a loss of potential yield since these shrimp were harvested well before the desired size indicated in the FMP. The Texas closure protected large quantities of small shrimp from fishing during the period of closure, which resulted in average catches of shrimp in the 31-40 count category in July and August. This was not true in Louisiana in July, when large quantities of 68-count and smaller shrimp were caught in the offshore fishery. If the Texas season had been opened in June and the first two weeks in July, we predict

that large quantities of small shrimp would have been harvested, similar to that observed in Louisiana and some of these shrimp possibly would have been discarded. However, because of the Texas closure, there was little or no discarding or wastage of small shrimp in Texas waters.

We conclude that the overall biomass in 1982 is approximately 25% to 50% lower than that observed in 1981. The inshore fisheries of Texas and Louisiana probably affect ultimate offshore production in both areas. In Louisiana in 1981 when there was peak abundance of brown shrimp throughout the western Gulf of Mexico, the inshore production amounted to 15.2 million pounds, yet the May-Aug offshore catch yielded a high of 23.1 million pounds. However, in 1982 with a much lower level of biomass, the inshore Louisiana fishery still produced 15.1 million pounds of shrimp but the offshore production was reduced to 13.7 million pounds.

In Texas the inshore fishery is significantly smaller than in Louisiana, about 4 million pounds, and is limited to a few geographical areas and is restricted on take per day. Thus, the effect on ultimate offshore production is probably smaller than in Louisiana.

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Table 1. Results of 2-way ANOVA with paired observations comparing catch data - Sept 1981-Apr 1982 from statistical subareas 13-17 and 18-21.

Source of Variation	Degrees of Freedom	Mean Square	F
Areas	1	.2090	3.47 n.s.
Months	7	.3285	5.46*
Error	7	.0601	
Total	15		

* = P ‹0.05

Table 2. Results of 2-way ANOVA with paired observations comparing fishing effort data - Sept 1981-Apr 1982 for statistical subareas 13-17 and 18-21.

Source of Variation	Degree of Freedom	Mean Square Error	F
Areas	1	15.015	6.82*
Months	7	3.80	1.73 n.s.
Error	7	2.20	
Total	15		

* P = ⟨0.001

Table 3. Results of 2-way ANOVA with paired observations comparing CPUE, Sept 1981-Apr 1982 from statistical subareas 13-17 and 18-21.

Source of Variation	Degree of Freedom	Mean Square Error	F
Areas	1	5.36	1.26 n.s.
Months	7	03.80	7.25***
Error	7	4.25	
Total	15		

*** = P <0.001

Table 4. Monthly summary of total offshore brown shrimp catch in millions of pounds, total fishing effort in 1000's of days and average CPUE for Louisiana statistical subareas 13-17, and Texas statistical subareas 18-21 for 1972-1981 (1980 not included)

	May		June		July		Aug.	
Area	13-17	18-21	13-17	18-21	13-17	18-21	13-17	18-21
1972								
Catch	1.1	0.8	1.3	3.1	2.9	7.9	4.6	9.5
Effort	1.7	1.2	2.0	4.3	3.1	6.9	5.0	9.6
CPUE	637	612	667	724	940	1155	924	989
1973								
Catch	0.8	0.7	2.5	2.8	1.1	7.2	1.3	4.0
Effort	1.9	2.9	3.7	3.0	2.8	7.3	3.2	10.2
CPUE	423	261	673	925	402	989	406	392
1974								
Catch	0.8	0.6	1.1	1.8	2.1	5.9	1.9	7.1
Effort	2.2	2.9	2.3	3.9	3.3	7.3	3.0	10.8
CPUE	374	219	480	455	628	806	637	657
1975								
Catch	1.0	0.5	0.7	2.7	1.5	6.1	1.4	5.4
Effort	1.4	2.2	1.4	3.4	2.0	6.8	2.3	8.2
CPUE	724	208	529	797	723	891	620	651
1976								
Catch	1.4	0.8	3.8	1.2	4.8	6.2	3.1	5.3
Effort	3.2	3.1	5.0	2.5	5.4	7.4	3.6	8.8
CPUE	456	246	770	497	880	839	866	607
1977								
Catch	3.6	0.5	6.4	2.1	5.9	8.6	5.9	8.1
Effort	4.3	3.6	7.7	2.8	6.3	7.5	6.3	9.0
CPUE	839	150	835	771	935	1147	943	891
1978								
Catch	5.3	0.8	5.6	2.6	8.5	5.4	5.1	6.3
Effort	7.7	3.8	8.0	3.8	9.0	5.5	7.2	8.4
CPUE	685	217	708	677	941	982	713	746
1979								
Catch	4.1	0.9	5.7	1.9	4.2	3.9	5.3	3.5
Effort	7.6	3.2	10.4	3.3	14.7	5.6	9.6	6.3
CPUE	536	271	554	582	285	685	555	548
1980								
Catch								
Effort								
CPUE								
1981								
Catch	5.0	0.4	7.6	-	7.5	10.4	3.0	14.6
Effort	5.8	1.1	9.0	-	8.1	4.4	3.8	10.4
CPUE	861	308	842	-	927	2382	799	1408
1982								
Catch	3.3	0.8	5.3	-*	3.3	6.6	1.8	6.4
Effort	5.4	2.6	8.8	-	6.4	5.2	3.4	10.2
CPUE	609	295	604	-	525	1279	522	629

*47,000 pounds landed.

Table 4. Monthly summary of total offshore brown shrimp catch in millions of pounds, total fishing effort in 1000's of days and CPUE for Louisiana statistical subareas 13-17, and Texas statistical subareas 18-21 for 1972-1981 (1980 not included)

	May		June		July		Aug.	
Area	13-17	18-21	13-17	18-21	13-17	18-21	13-17	18-21
1972								
Catch	1.1	0.8	1.3	3.1	2.9	7.9	4.6	9.5
Effort	1.7	1.2	2.0	4.3	3.1	6.9	5.0	9.6
CPUE	637	612	667	724	940	1155	924	989
1973								
Catch	0.8	0.7	2.5	2.8	1.1	7.2	1.3	4.0
Effort	1.9	2.9	3.7	3.0	2.8	7.3	3.2	10.2
CPUE	423	261	673	925	402	989	406	392
1974								
Catch	0.8	0.6	1.1	1.8	2.1	5.9	1.9	7.1
Effort	2.2	2.9	2.3	3.9	3.3	7.3	3.0	10.8
CPUE	374	219	480	455	628	806	637	657
1975								
Catch	1.0	0.5	0.7	2.7	1.5	6.1	1.4	5.4
Effort	1.4	2.2	1.4	3.4	2.0	6.8	2.3	8.2
CPUE	724	208	529	797	723	891	620	651
1976								
Catch	1.4	0.8	3.8	1.2	4.8	6.2	3.1	5.3
Effort	3.2	3.1	5.0	2.5	5.4	7.4	3.6	8.8
CPUE	456	246	770	497	880	839	866	607
1977								
Catch	3.6	0.5	6.4	2.1	5.9	8.6	5.9	8.1
Effort	4.3	3.6	7.7	2.8	6.3	7.5	6.3	9.0
CPUE	839	150	835	771	935	1147	943	891
1978								
Catch	5.3	0.8	5.6	2.6	8.5	5.4	5.1	6.3
Effort	7.7	3.8	8.0	3.8	9.0	5.5	7.2	8.4
CPUE	685	217	708	677	941	982	713	746
1979								
Catch	4.1	0.9	5.7	1.9	4.2	3.9	5.3	3.5
Effort	7.6	3.2	10.4	3.3	14.7	5.6	9.6	6.3
CPUE	536	271	554	582	285	685	555	548
1980								
Catch								
Effort								
CPUE								
1981								
Catch	5.0	0.4	7.6	-	7.5	10.4	3.0	14.6
Effort	5.8	1.1	9.0	-	8.1	4.4	3.8	10.4
CPUE	861	308	842	-	927	2382	799	1408
1982								
Catch	3.3	0.8	5.3	-*	3.3	6.6	1.8	6.4
Effort	5.4	2.6	8.8	-	6.4	5.2	3.4	10.2
CPUE	609	295	604	-	525	1279	522	629

*47,000 pounds landed.

Table 4. cont. Monthly summary of total offshore brown shrimp catch in millions of pounds, total fishing effort in 1000's of days and CPUE for Louisiana statistical subareas 13-17, and Texas statistical subareas 18-21 for 1972-1981 (1980 not included)

	Jan.		Feb.		Mar.		Apr.	
Area	13-17	18-21	13-17	18-21	13-17	18-21	13-17	18-21
1972								
Catch	0.5	0.9	0.5	0.5	0.7	0.4	0.2	0.3
Effort	0.9	2.0	1.1	1.6	1.8	1.2	0.6	1.3
CPUE	541	451	469	304	368	349	274	212
1973								
Catch	1.1	0.4	0.8	0.3	0.8	0.4	0.5	0.4
Effort	1.6	1.4	2.0	0.7	2.0	1.0	1.2	1.7
CPUE	695	272	414	439	400	350	411	222
1974								
Catch	0.5	1.1	0.4	0.6	0.3	0.5	0.2	0.4
Effort	1.1	1.7	1.0	1.5	0.8	1.5	0.6	1.9
CPUE	448	653	408	427	385	301	308	202
1975								
Catch	0.4	0.7	0.4	0.6	0.4	0.3	0.2	0.2
Effort	0.5	1.8	1.1	1.7	1.0	1.0	0.6	0.0
CPUE	754	407	376	327	388	293	324	0.0
1976								
Catch	0.8	0.5	0.6	0.6	0.4	0.4	0.5	0.5
Effort	1.4	1.3	1.3	2.0	1.0	1.7	1.2	2.1
CPUE	534	384	501	289	401	245	370	227
1977								
Catch	0.5	0.2	0.4	0.2	0.5	0.1	0.4	0.3
Effort	1.8	1.0	1.6	0.9	1.8	0.7	1.8	1.5
CPUE	296	193	249	163	274	149	232	201
1978								
Catch	0.9	0.7	1.1	0.5	1.4	1.2	0.5	0.4
Effort	1.1	2.0	2.1	1.3	3.4	0.9	1.2	1.6
CPUE	836	353	531	371	413	174	438	247
1979								
Catch	0.7	0.7	1.0	0.6	0.8	0.5	0.6	0.4
Effort	1.9	2.3	2.0	2.4	2.3	2.1	2.0	1.5
CPUE	374	312	524	266	361	235	312	293
1980								
Catch								
Effort								
CPUE								
1981								
Catch	0.2	0.3	0.1	0.1	0.2	0.06	0.08	0.06
Effort	0.6	1.0	0.4	0.4	0.4	0.3	.04	0.2
CPUE	319	253	329	296	387	228	195	301
1982								
Catch	0.5	0.6	0.6	0.6	0.4	0.2	0.2	0.2
Effort	0.9	1.4	1.2	1.9	1.1	0.6	0.7	0.8
CPUE	549	454	446	317	370	276	281	271

Table 4. cont. Monthly summary of total offshore brown shrimp catch in millions of pounds, total fishing effort in 1000's of days and CPUE for Louisiana statistical subareas 13-17, and Texas statistical subareas 18-21 for 1972-1981 (1980 not included)

	Totals and Averages for May-June		Totals and Averages for July-Aug.		Totals and Averages for Sept.-Dec.		Totals and Averages for Jan.-Apri.	
Area	13-17	18-21	13-17	18-21	13-17	18-21	13-17	18-21
1972								
Catch	2.4	3.9	7.5	17.4	5.1	13.1	1.9	2.1
Effort	3.7	5.5	8.1	16.5	6.3	21.1	4.4	6.1
CPUE	652	668	932	1072	950	588	413	329
1973								
Catch	3.3	3.5	2.4	11.2	1.8	7.1	3.2	1.5
Effort	5.6	5.9	6.0	17.5	3.5	15.1	6.8	4.8
CPUE	548	593	404	691	590	506	480	321
1974								
Catch	1.9	2.4	4.0	13.0	3.5	8.4	1.4	2.6
Effort	4.5	6.8	6.3	18.1	4.8	13.5	3.5	6.6
CPUE	427	337	633	732	807	575	387	396
1975								
Catch	1.7	3.2	2.9	11.5	3.1	8.3	1.4	1.8
Effort	2.8	5.6	4.3	15.0	4.1	16.5	3.2	4.5
CPUE	627	503	671	771	940	497	461	257
1976								
Catch	5.2	2.0	7.9	11.5	5.7	10.7	2.3	2.0
Effort	8.2	5.6	9.0	16.5	9.6	19.1	4.9	7.1
CPUE	613	372	873	723	590	504	452	286
1977								
Catch	10.0	2.6	11.8	16.7	5.8	12.6	1.8	0.8
Effort	12.0	6.5	12.6	16.5	8.1	20.7	7.0	4.1
CPUE	837	461	939	1019	765	586	263	177
1978								
Catch	10.9	3.4	13.6	11.7	4.1	10.9	3.9	1.8
Effort	15.7	7.6	16.2	13.9	8.9	24.4	7.8	5.8
CPUE	697	447	827	864	451	436	555	286
1979								
Catch	9.8	2.8	9.5	7.4	4.1	6.4	3.1	2.2
Effort	18.0	6.5	24.3	11.9	11.2	15.0	8.2	8.3
CPUE	545	427	420	617	387	420	393	277
1980								
Catch								
Effort								
CPUE								
1981								
Catch	12.6	0.4	10.5	25.0	4.3	14.1	0.6	0.5
Effort	14.8	1.1	11.9	14.8	6.6	21.1	1.8	1.9
CPUE	852	308	863	1895	654	648	308	269
1982								
Catch	8.6	0.8	5.1	13.1	-	-	1.7	1.6
Effort	14.2	2.6	9.8	15.7	-	-	3.9	4.7
CPUE	607	295	524	922	-	-	412	330

Table 5. Results of t-tests of monthly catch, fishing effort and CPUE for statistical subareas 18-21 from Sept 1981-Apr 1982 versus the means for these months based on the historical data set 1960-1979.

Month	Catch	Effort	CPUE
Sept	0.691	0.194	1.361
Oct	1.161	1.343	0.296
Nov	0.943	0.812	0.426
Dec	0.507	1.425	0.333
Jan	0.612	0.033	0.551
Feb	0.032	0.963	0.177
Mar	0.646	0.741	0.087
Apr	1.068	0.959	0.221

$t_{.05(2)19} = 2.093$

Table 6. Results of t-tests of monthly catch, fishing effort and CPUE for statistical subareas 18-21 from Sept 1981-Apr 1982 versus the means for these months based on the historical data set 1975-1979.

Month	Catch	Effort	CPUE
Sept	0.862	0.045	0.070
Oct	1.201	0.875	0.883
Nov	1.534	0.033	0.791
Dec	0.995	0.076	0.999
Jan[1]	0.310	0.515	0.207
Feb[1]	0.499	0.343	0.416
Mar[1]	0.445	0.928	0.897
Apr[1]	1.727	2.931	0.665

$t_{.05}(2)4 = 2.776$

$t_{.05}(2)3 = 3.186$

[1]Based on four years; no 1980 data.

Table 7. Mean No./ha (Log 10 + 1) of brown shrimp (Penaeus aztecus) captured by 60-ft wide bag siene (all stations combined) along shorelines of Galveston, Matagorda, San Antonio, Aransas, Corpus Christi Bays and the Laguna Madre (upper and lower) during Apr-Aug 1978-1982* (Number in parenthesis indicates number of samples).

Year	April Mean No./ha ± 1 S.E.	May Mean No./ha ± 1 S.E.	June Mean No./ha ± 1 S.E.	July Mean No./ha ± 1 S.E.	August Mean No./ha ± 1 S.E.
1978	0.65 ± 0.41 (41)	2.58 ± 0.41 (42)	NS	1.63 ± 0.45 (40)	1.02 ± 0.44 (42)
1979	0.58 ± 0.38 (42)	1.85 ± 0.53 (42)	1.98 ± 0.53 (41)	1.22 ± 0.51 (42)	1.13 ± 0.43 (42)
1980	0.37 ± 0.25 (42)	2.30 ± 0.49 (42)	2.40 ± 0.27 (41)	1.70 ± 0.49 (42)	1.32 ± 0.48 (40)
1981	2.03 ± 0.50 (42)	2.64 ± 0.51 (42)	1.93 ± 0.52 (42)	1.82 ± 0.47 (42)	1.14 ± 0.51 (42)
1982	1.77 ± 0.33 (70)	2.58 ± 0.31 (70)	2.31 ± 0.37 (70)	1.69 ± 0.31 (70)	1.56 ± 0.31 (70)

*Source C. E. Bryan, Texas Parks and Wildlife.

Table 8. Inshore brown shrimp catch, 1982, in 1000 of pounds - Louisiana from the Mississippi River to Texas.

Size Count	May	June	July	Aug	Total
15	—	--	--	--	--
16-20	--	--	--	--	--
21-25	1.4	—	--	--	1.4
26-30	--	—	--	2.5	2.5
31-40	--	1.7	178.7	15.1	195.5
41-50	—	6.4	54.5	16.6	77.5
51-67	12.7	581.7	197.6	68.1	860.1
68-80	326.1	1,673.0	610.3	75.6	2,685.0
81-100	1,143.1	1,466.6	248.9	14.5	2,873.1
101-115	1,375.4	1,036.2	75.1	—	2,486.7
>116	3,716.8	2,115.3	120.8	—	5,952.9
TOTAL	6,575.5	6,880.9	1,485.9	192.4	15,134.7

Table 9. Texas inshore brown shrimp catch, 1982, in 1000 of pounds.

Size Count	May	June	July	Aug	Total
15	--	--	.1	--	.1
16-20	--	--	7.7	--	7.7
21-25	--	--	--	--	--
26-30	-	.2	.5	--	.7
31-40	--	.8	7.6	4.8	13.2
41-50	--	1.8	23.3	3.1	28.2
51-67	8.8	23.0	81.4	23.3	136.5
68-80	28.4	182.5	100.0	163.5	474.4
81-100	128.3	282.9	174.1	53.7	639.0
101-115	162.4	281.0	89.2	3.2	535.8
>116	843.1	1,224.3	139.0	15.1	2,221.5
TOTAL	1,171.0	1,996.5	622.9	266.7	4,057.1

Table 10. Results of t-tests of monthly catch, fishing effort and CPUE for statistical subareas 18-21 from July-Aug 1982 versus means for the same months based on the historical data set, 1960-1979.

Month	Catch	Effort	CPUE
July	0.338	1.327	1.260
Aug	0.170	1.389	0.524

$t_{.05(2)19} = 2.093$

Table 11. Results of t-tests of monthly catch, fishing effort and CPUE for statistical subareas 18-21 from July-Aug 1982 versus means for the same months based on the historical data set, 1975-1979.

Month	Catch	Effort	CPUE
July	0.397	1.346	1.833
Aug	0.446	1.789	0.391

$t_{.05(2)4} = 2.776$

Table 12. May-Aug catch of brown shrimp in millions of pounds from inshore and offshore Louisiana waters in statistical subareas 13-17 and in Texas waters in statistical subareas 18-21.

	1982	1981	1980	1979	1978
Louisiana:					
Inshore	15.1	15.2	7.3	10.6	14.1
Offshore	13.7	23.1	11.7	19.3	24.5
Total	28.8	38.3	19.0	29.9	38.6
Texas:					
Inshore	4.1	4.2	4.5	4.1	2.0
Offshore	13.9	25.3	12.6	10.1	15.1
Total	18.0	29.5	16.9	14.2	17.1

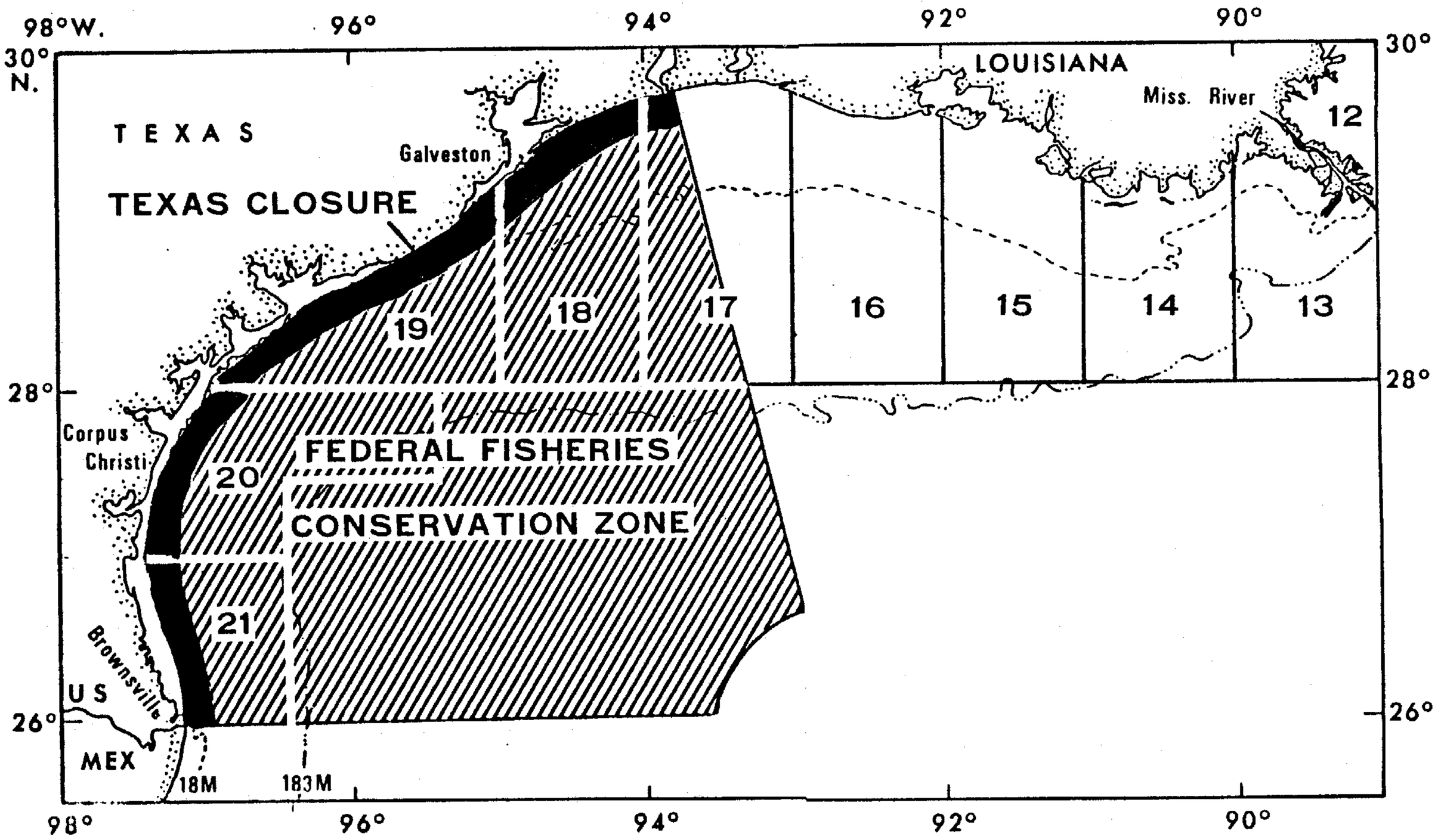


Figure 1. Location of statistical subareas and the Texas closure area.

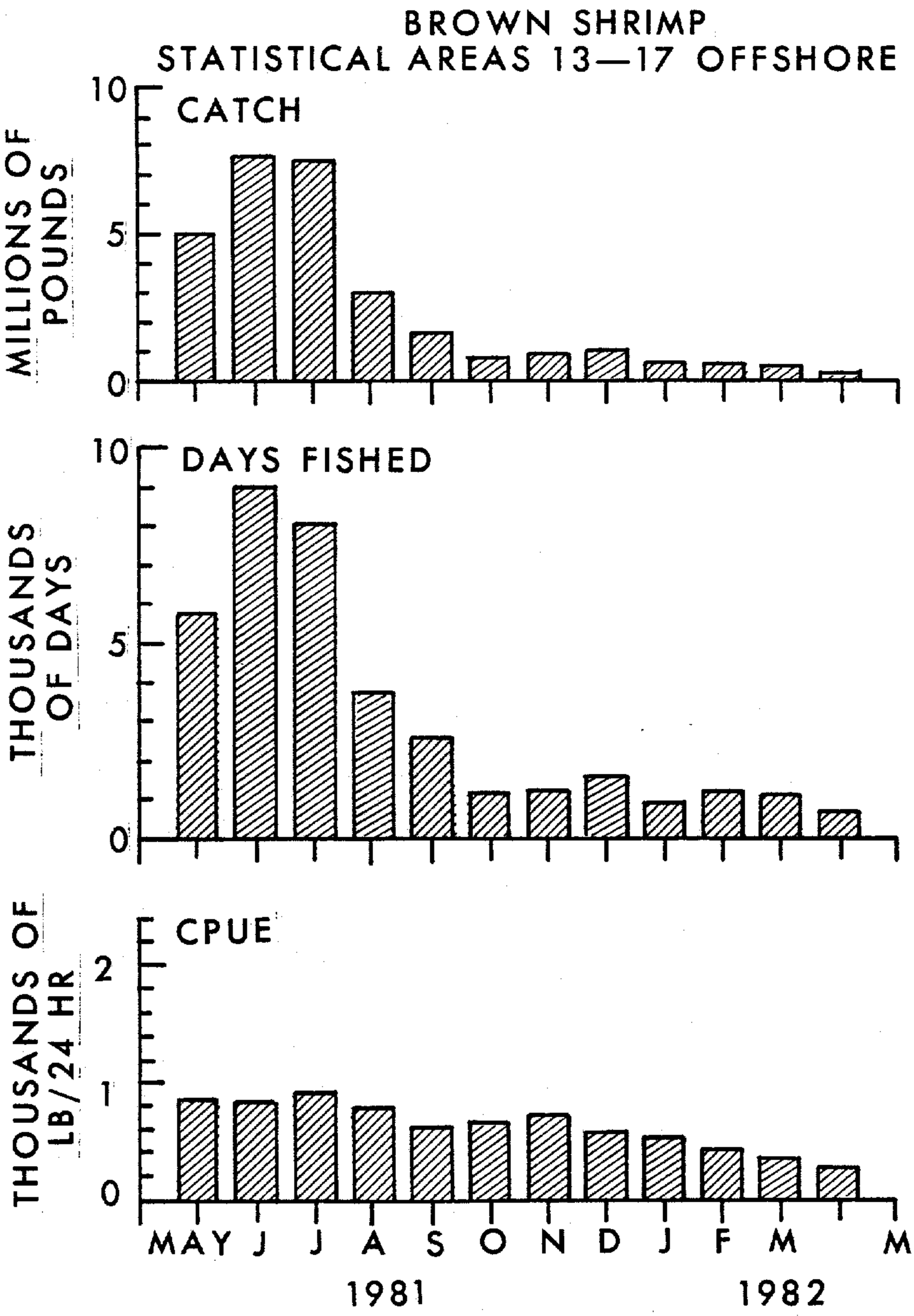


Figure 2. Commercial catch statistics from May 1981-Apr 1982 for statistical subareas 13-17 a) catch in millions of pounds, b) fishing effort in 1000s of days fished and c) CPUE.

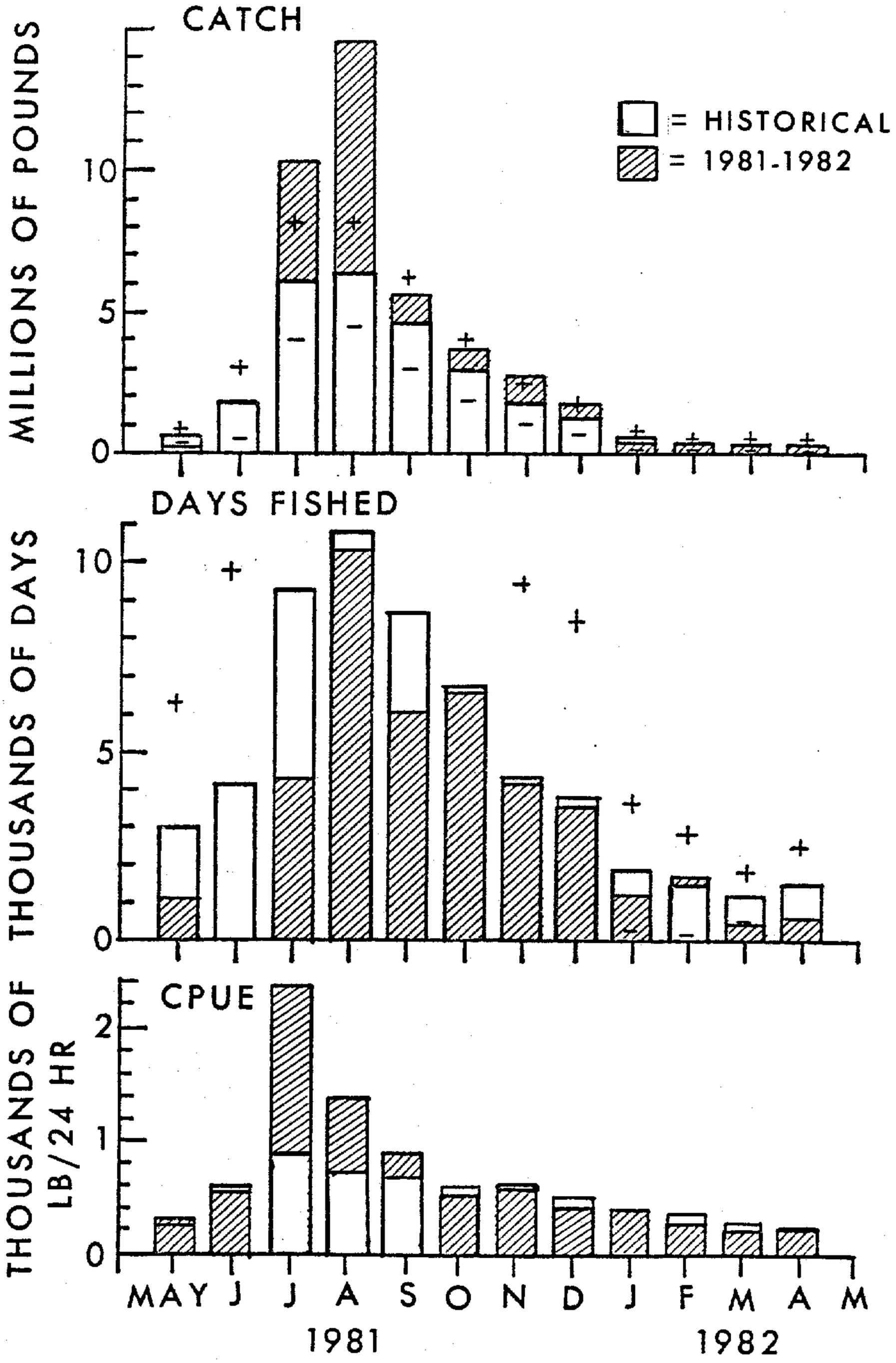


Figure 3. Commercial catch statistics from May 1981-Apr 1982 for statistical subareas 18-21 a) catch in millions of pounds, b) fishing effort in 1000s of days fished and c) CPUE.

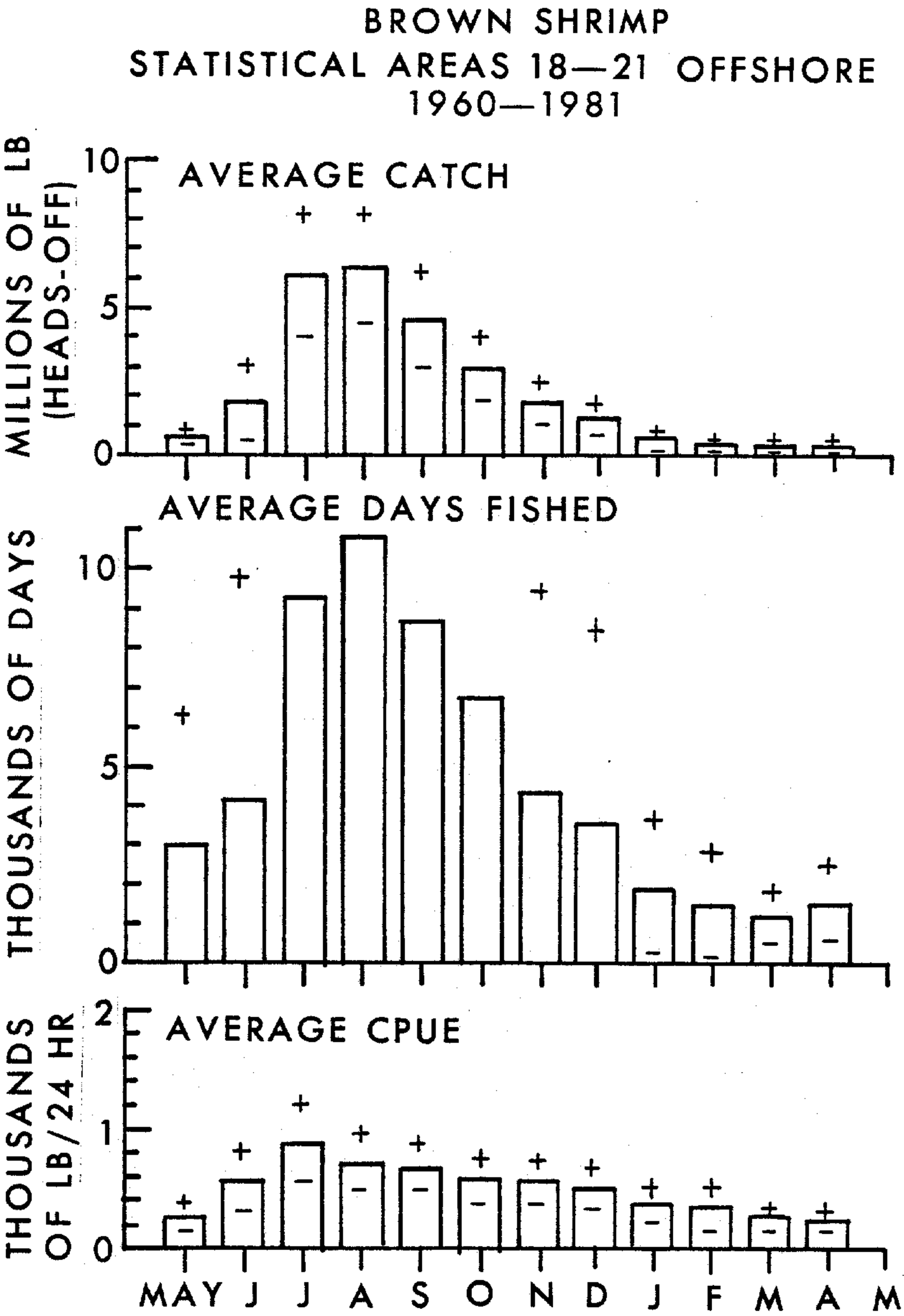


Figure 4. Average monthly historical commercial catch statistics with standard deviation (±) 1960-1981 for statistical subareas 18-21 a) average catch per month, b) average monthly fishing effort and c) average monthly CPUE.

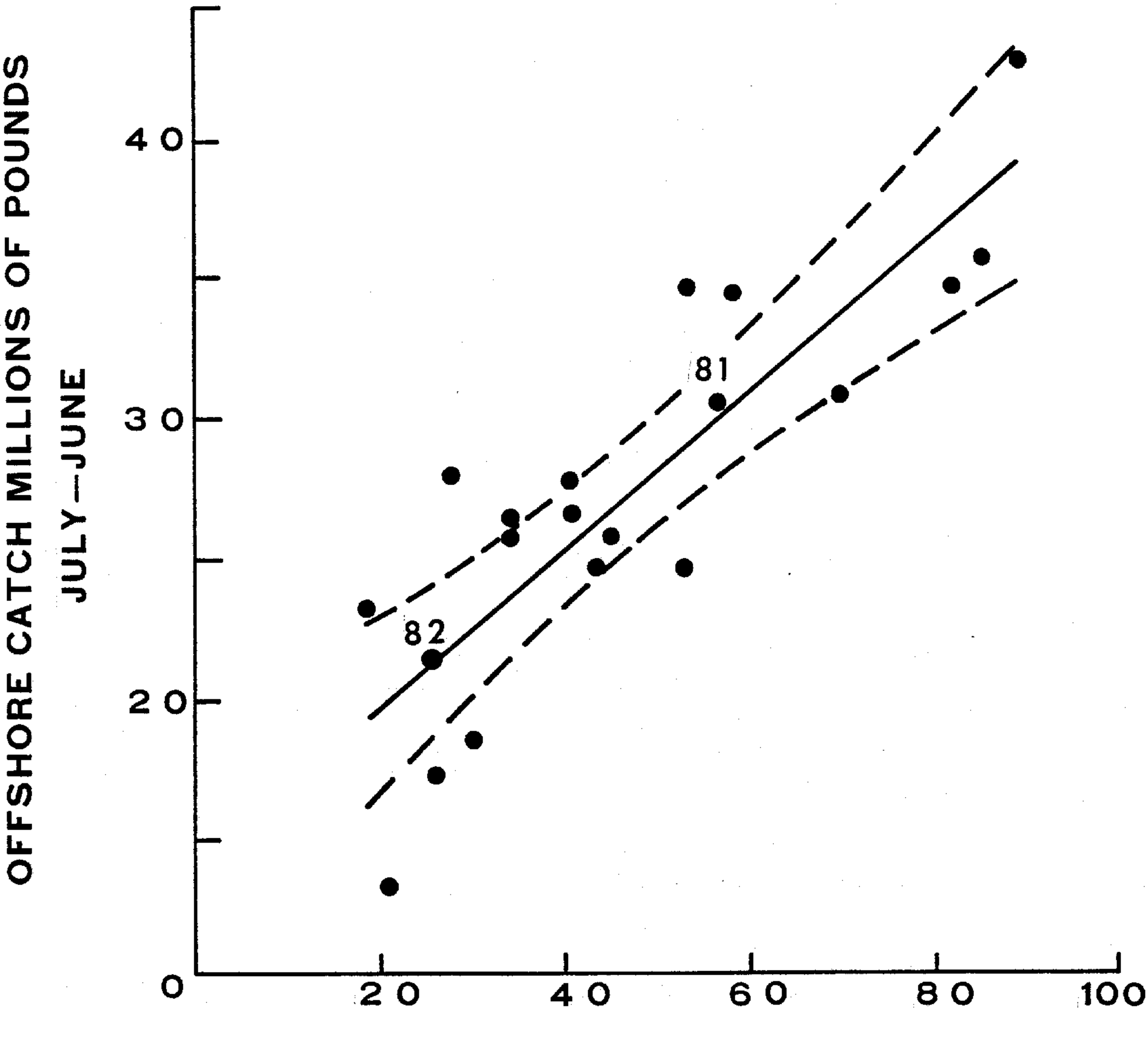


Figure 5. Predicted annual July-June brown shrimp offshore catch in Texas, 1960-1980.

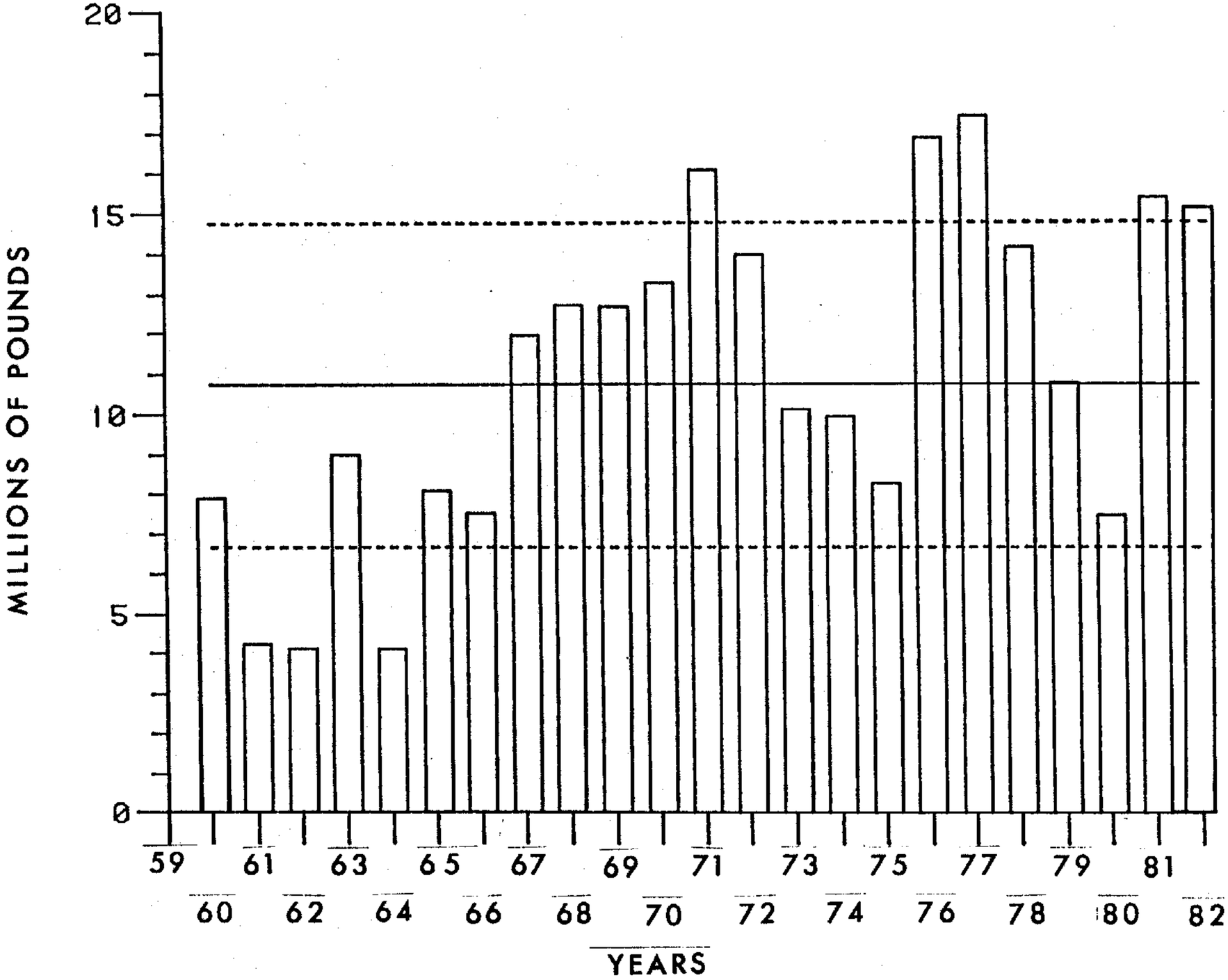
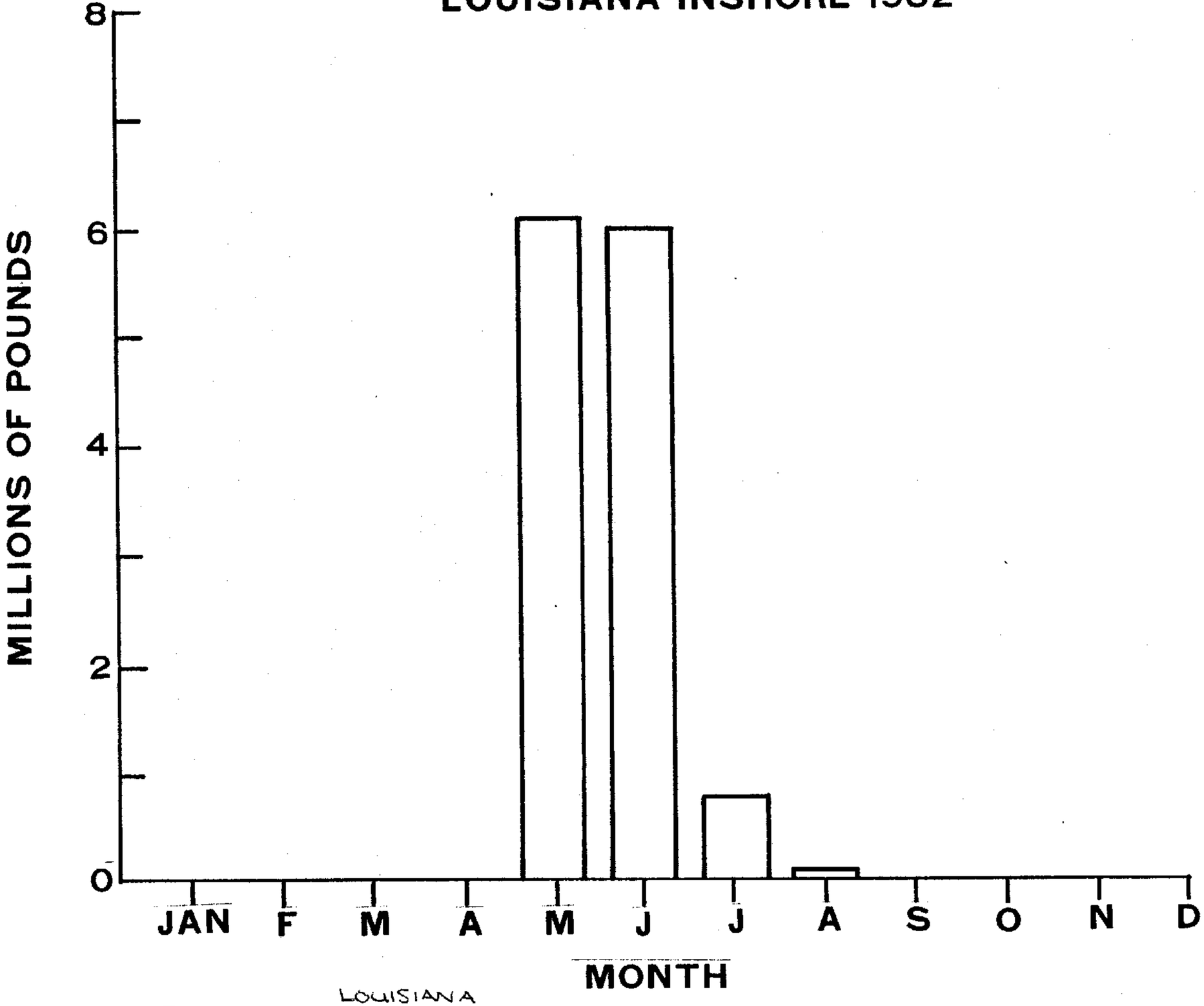


Figure 6. Annual inshore brown shrimp catch in Louisiana west of the Mississippi River (solid line is average and broken line is standard deviation).



LOUISIANA

Figure 7. 1982 ~~Texas~~ brown shrimp inshore catch by month.

ANNUAL INSHORE BROWN SHRIMP CATCH
TEXAS 1960—1982

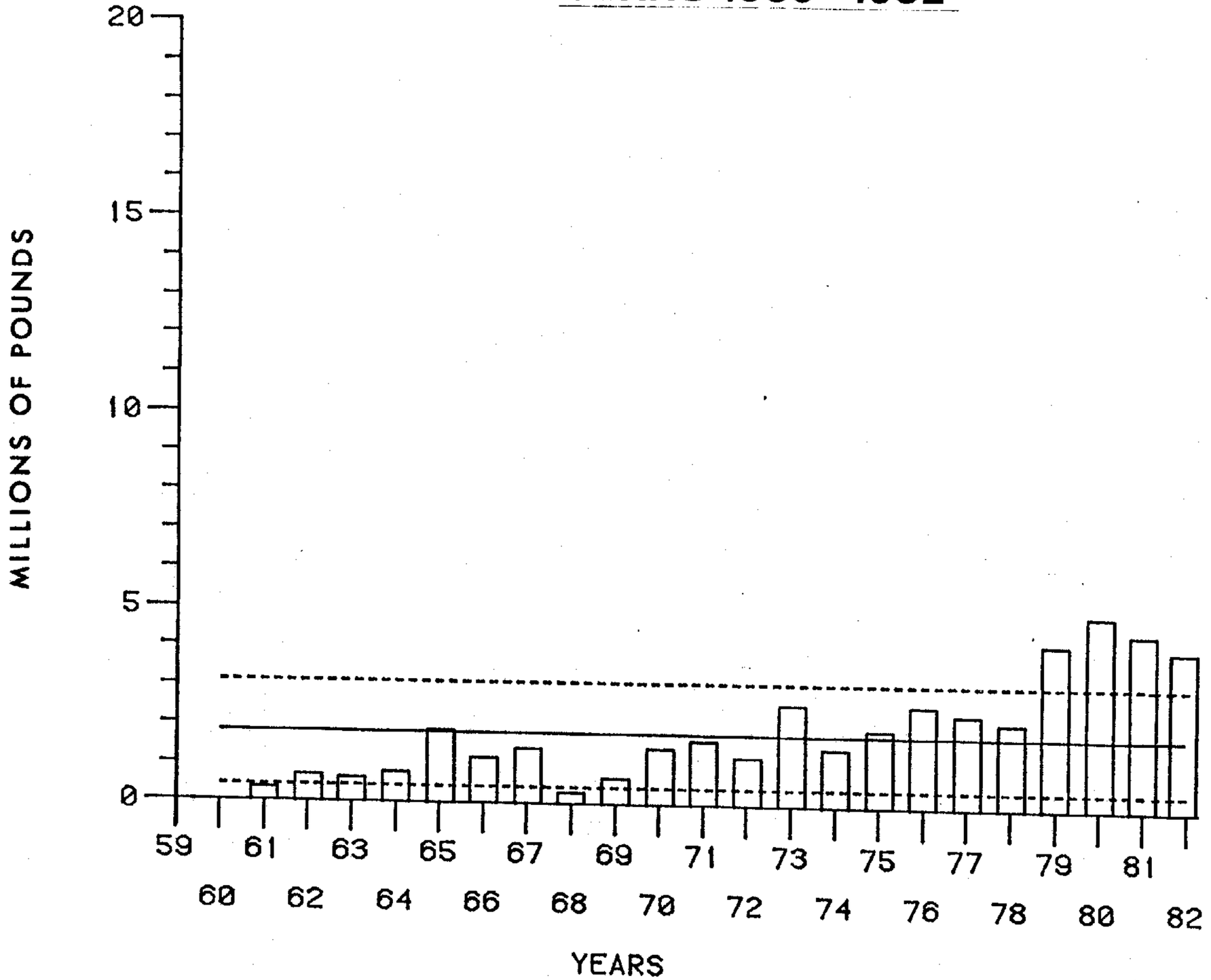


Figure 8. Annual Texas inshore brown shrimp catch (solid line is average and broken line is standard deviation).

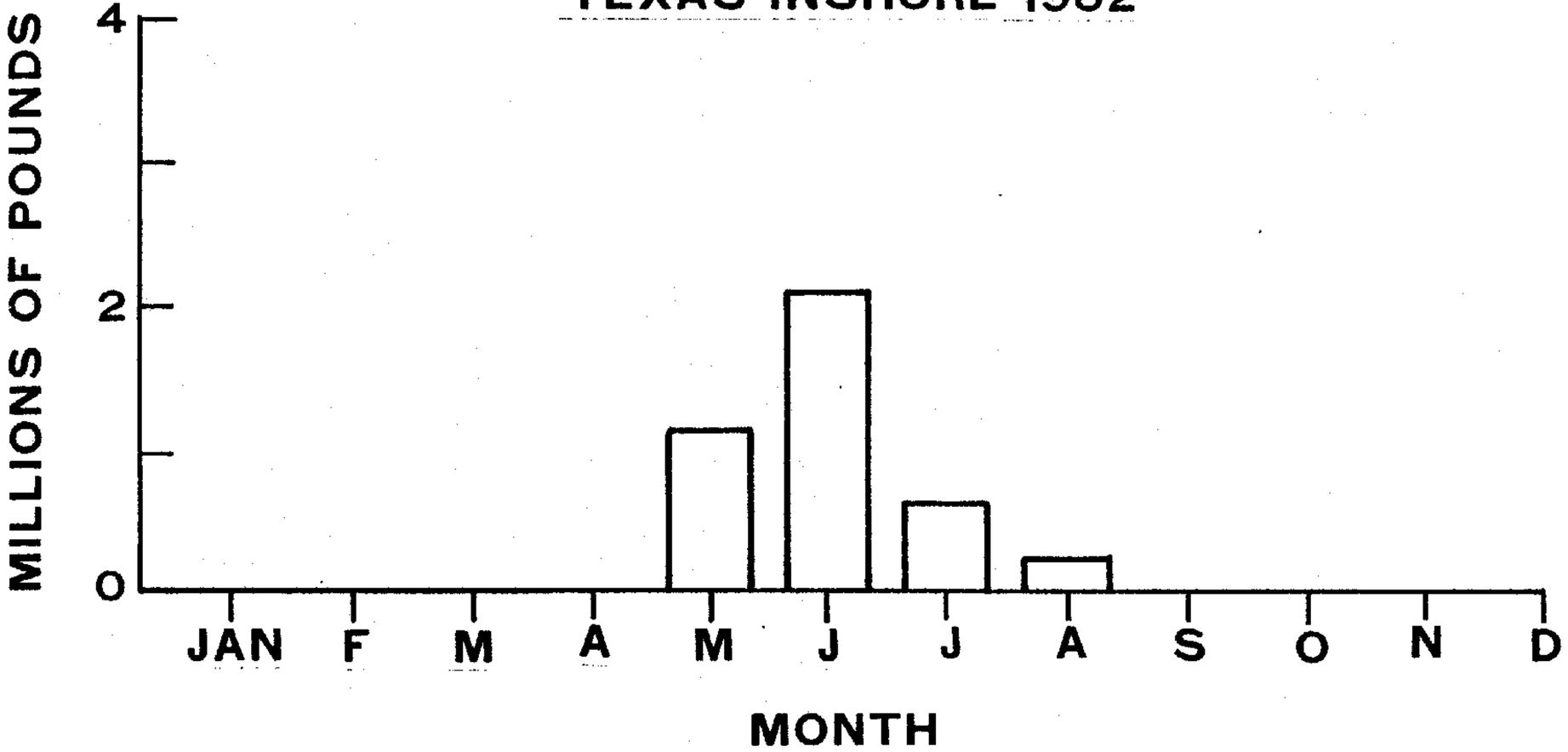


Figure 9. 1981 ~~Louisiana~~ TEXAS inshore catch by month.

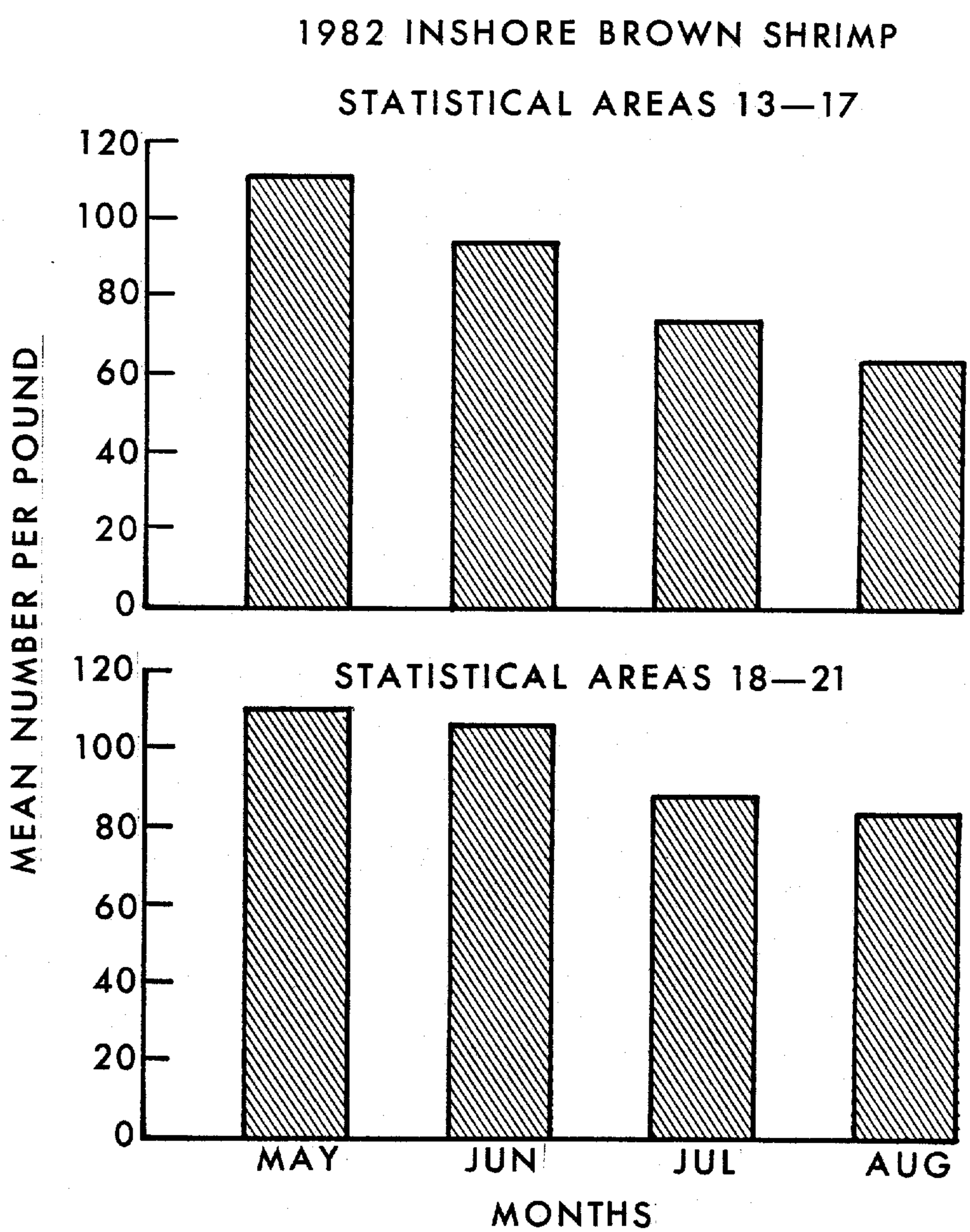


Figure 10. Average number of brown shrimp per pound caught in a) Louisiana inshore waters and b) Texas inshore waters using size categories 15/116-1b.

1982
STATISTICAL AREAS 13—17

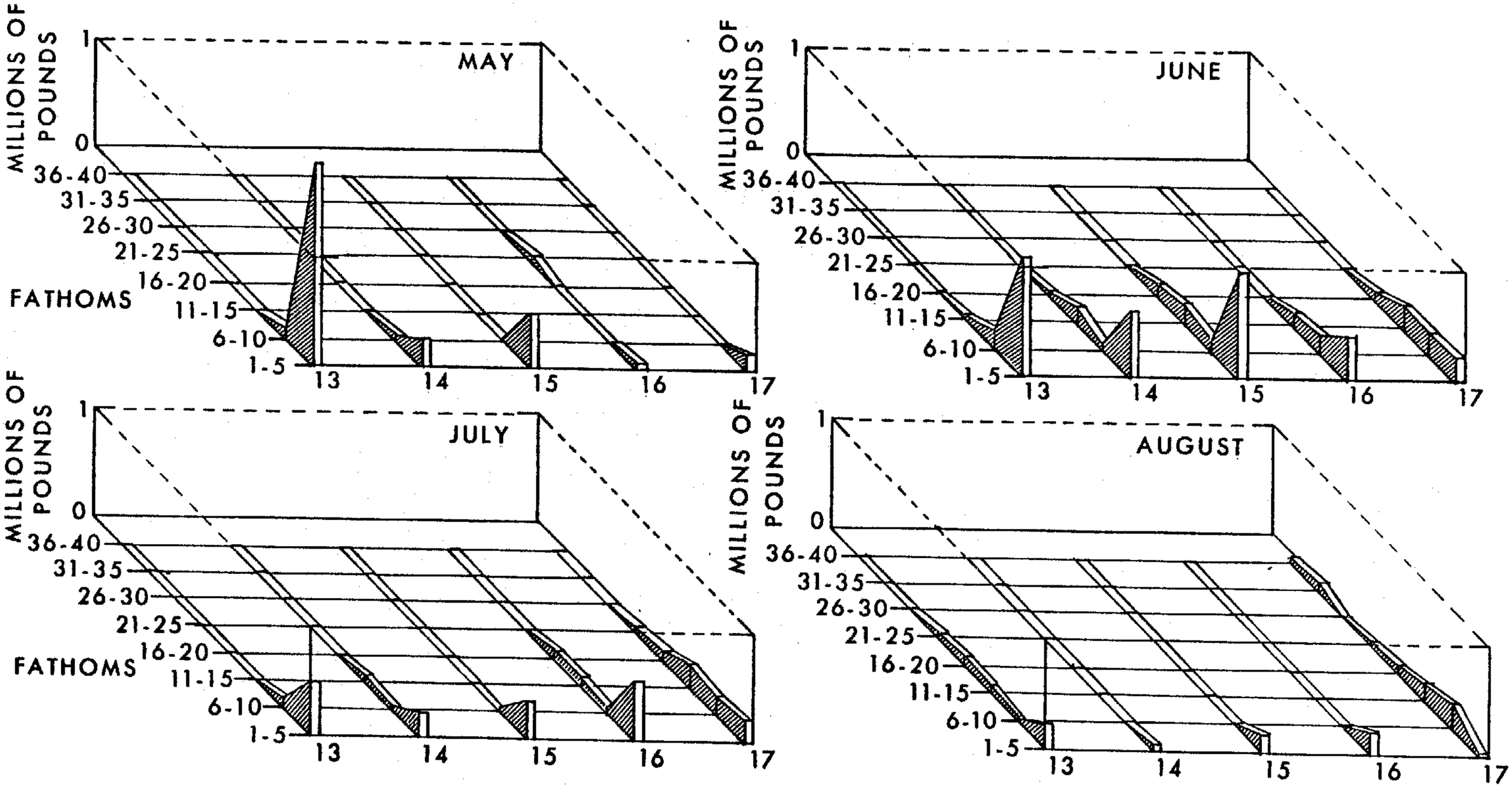


Figure 11. Offshore brown shrimp catch in statistical subareas 13-17 in a) May, b) June, c) July and d) August.

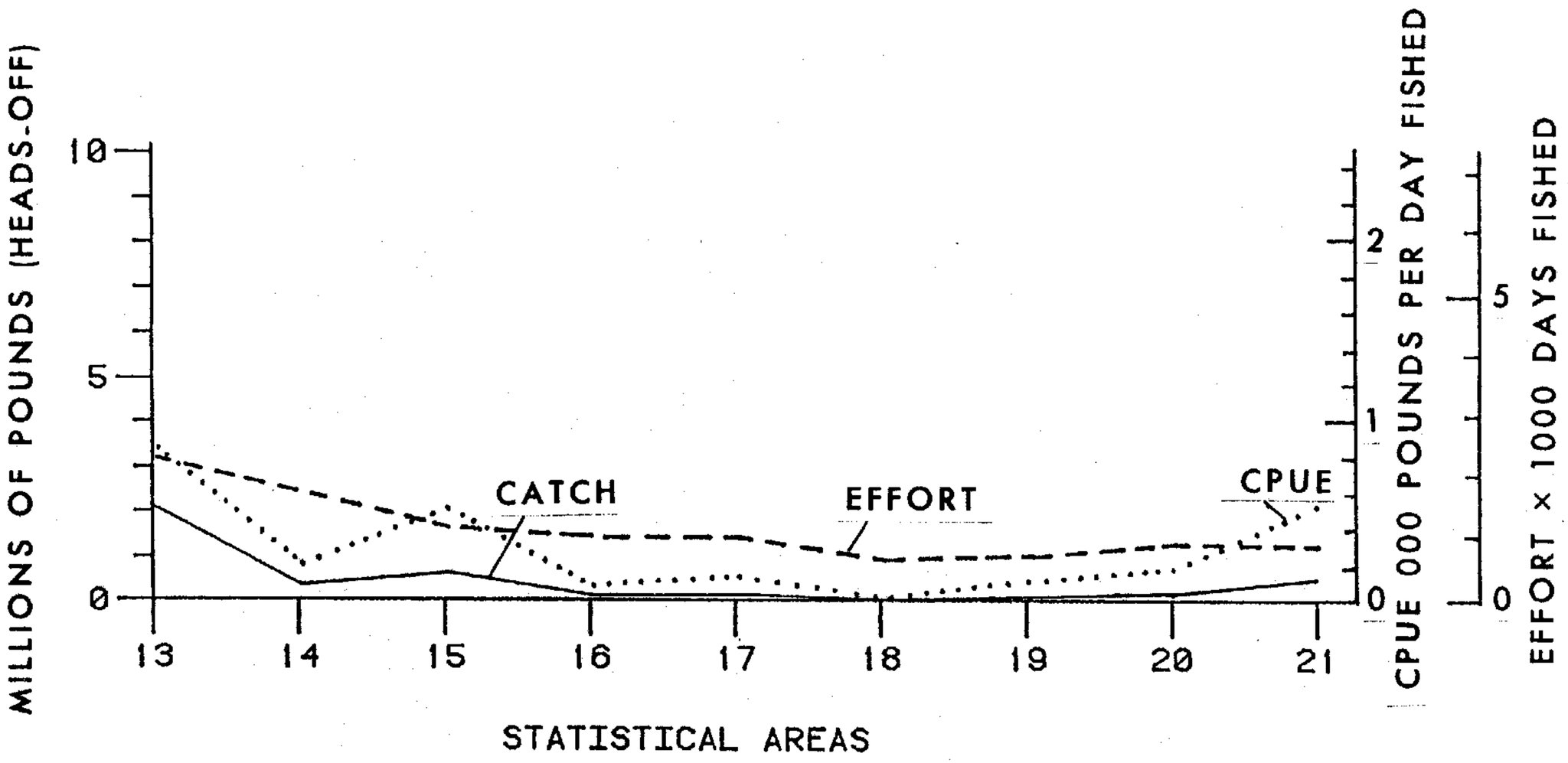


Figure 12. Offshore brown shrimp catch, fishing effort and CPUE in statistical subareas 13-21 in May 1982.

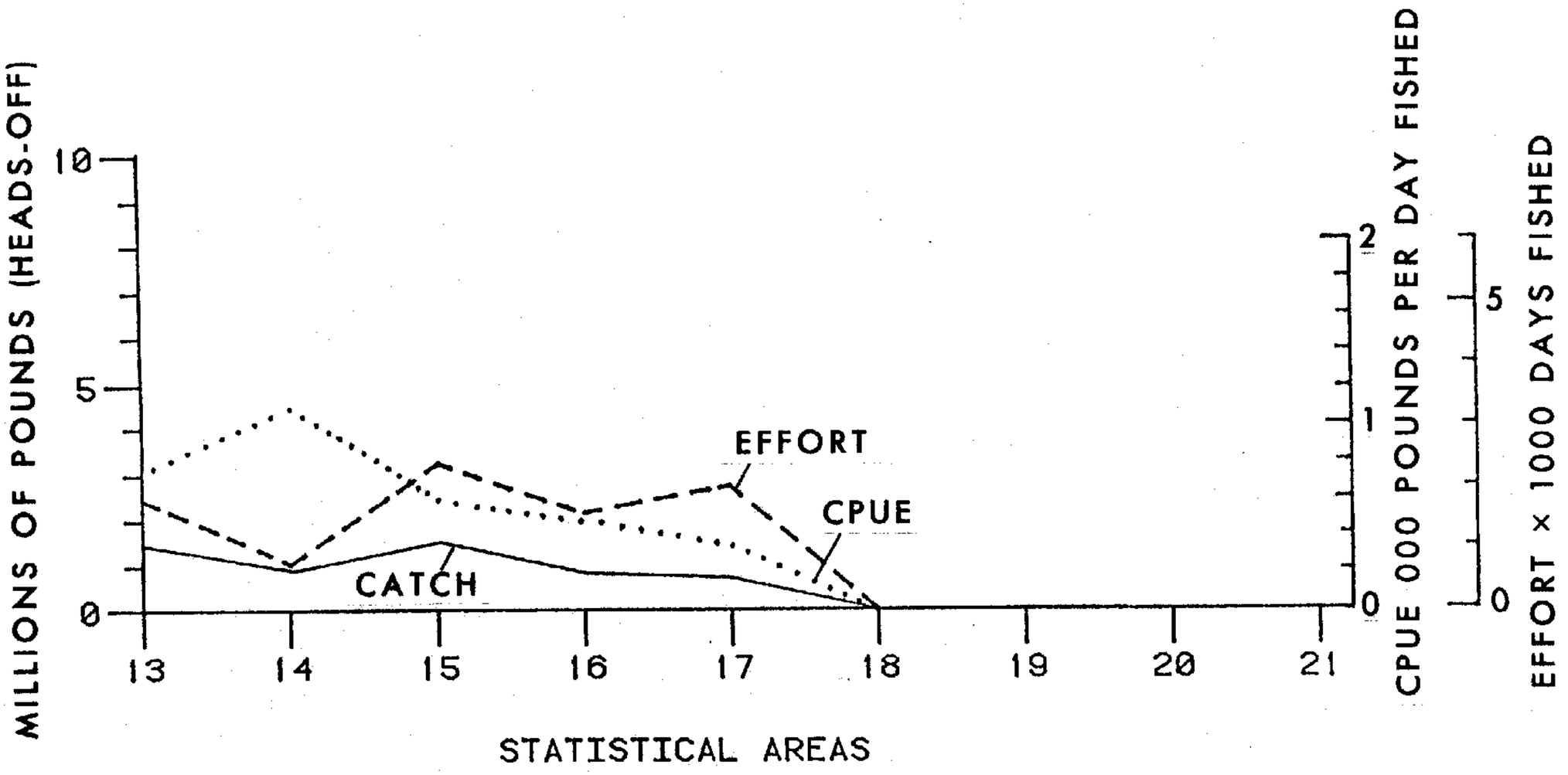


Figure 13. Offshore brown shrimp catch, fishing effort and CPUE in statistical subareas 13-21 in June 1982.

JULY 1982 BROWN SHRIMP OFFSHORE CATCH, FISHING EFFORT, AND CPUE

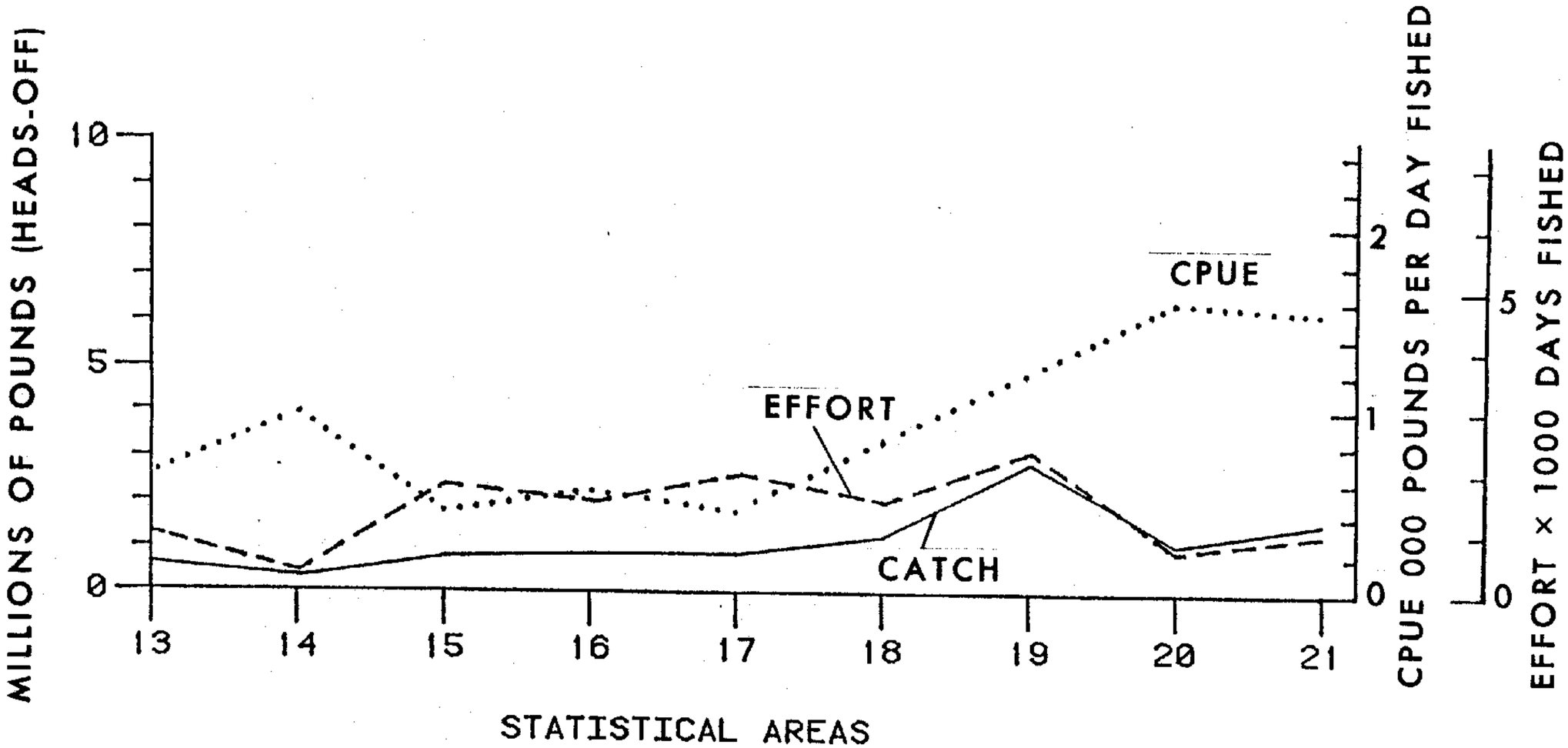


Figure 14. Offshore brown shrimp catch, fishing effort and CPUE in statistical subareas 13-21 in July 1982.

AUGUST 1982 BROWN SHRIMP CATCH, FISHING EFFORT, AND CPUE.

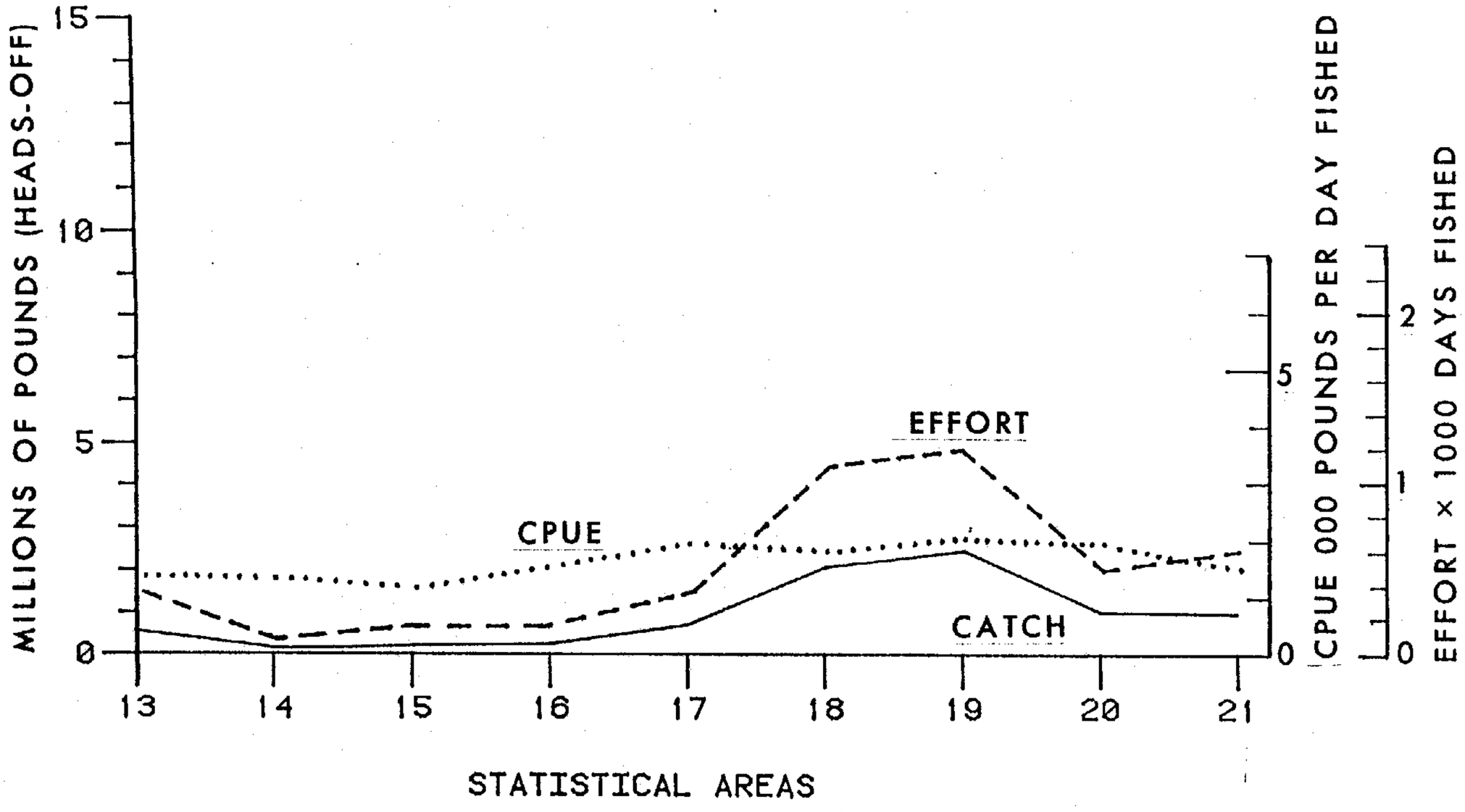


Figure 15. Offshore brown shrimp catch, fishing effort and CPUE in statistical subareas 13-21 in August 1982.

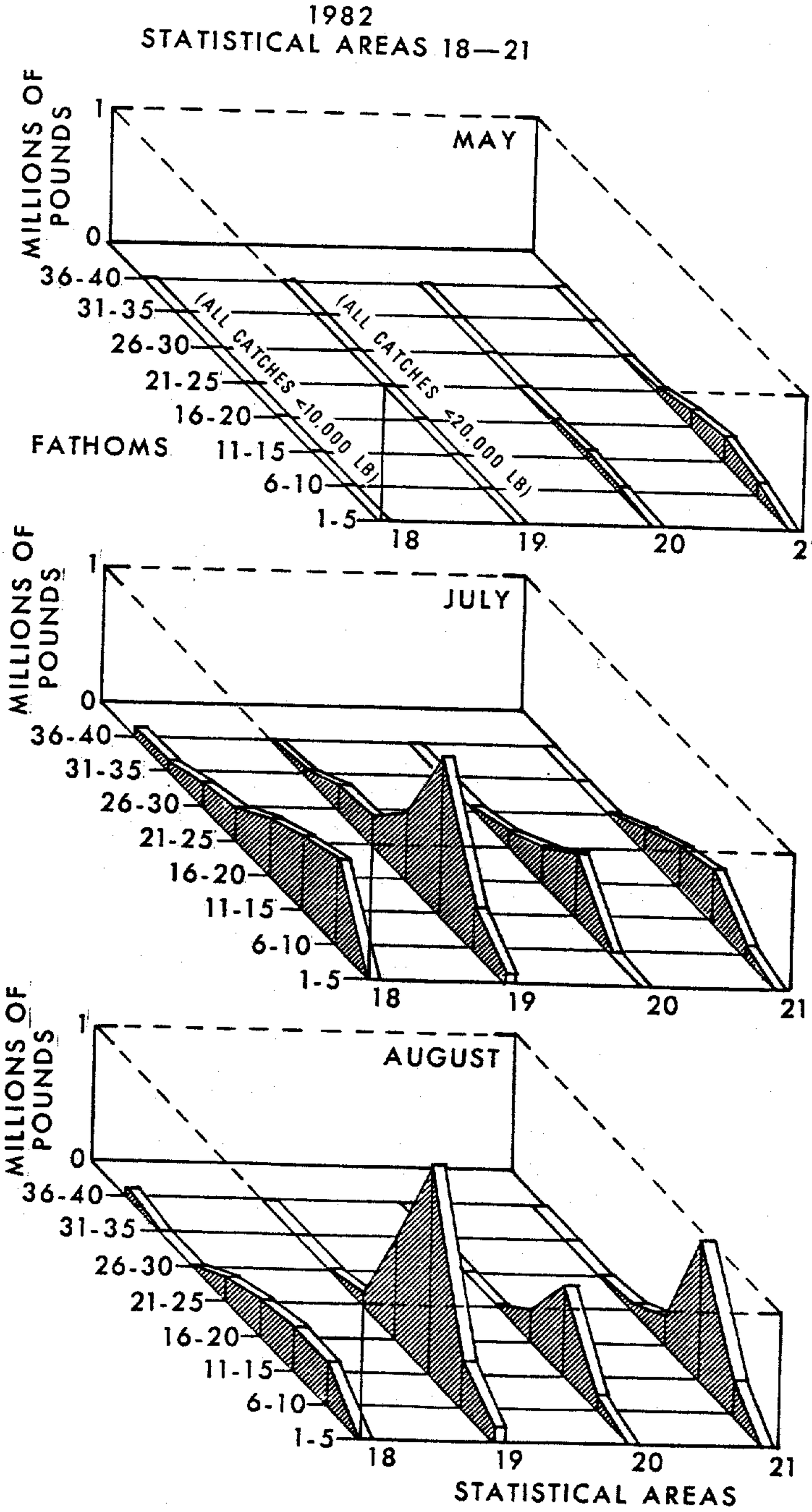


Figure 16. Offshore brown shrimp catch from statistical subareas 18-21 in a) May, b) July and c) August 1982.

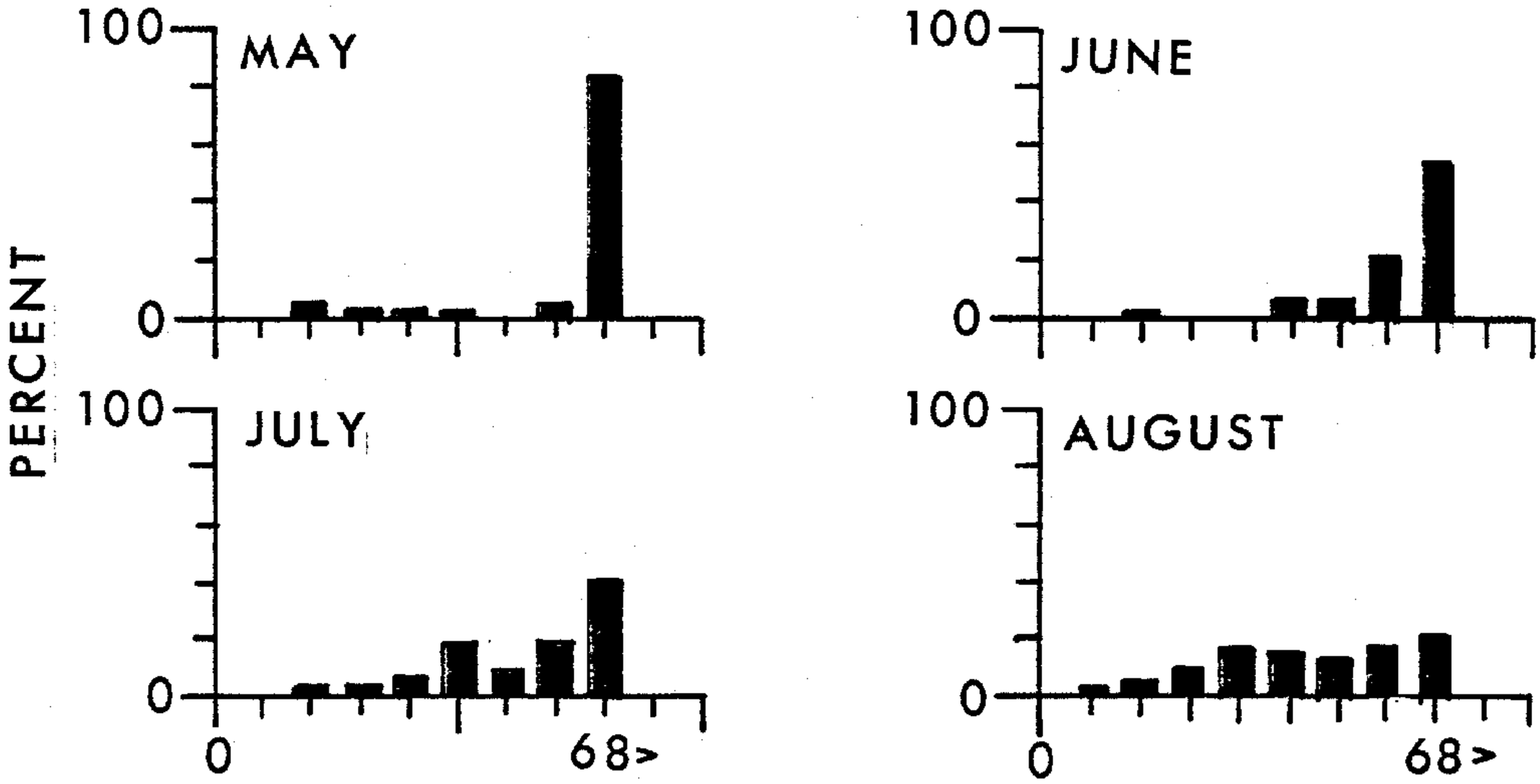


Figure 17. Percent size composition of brown shrimp caught in statistical subareas 13-17, May-Aug 1982.

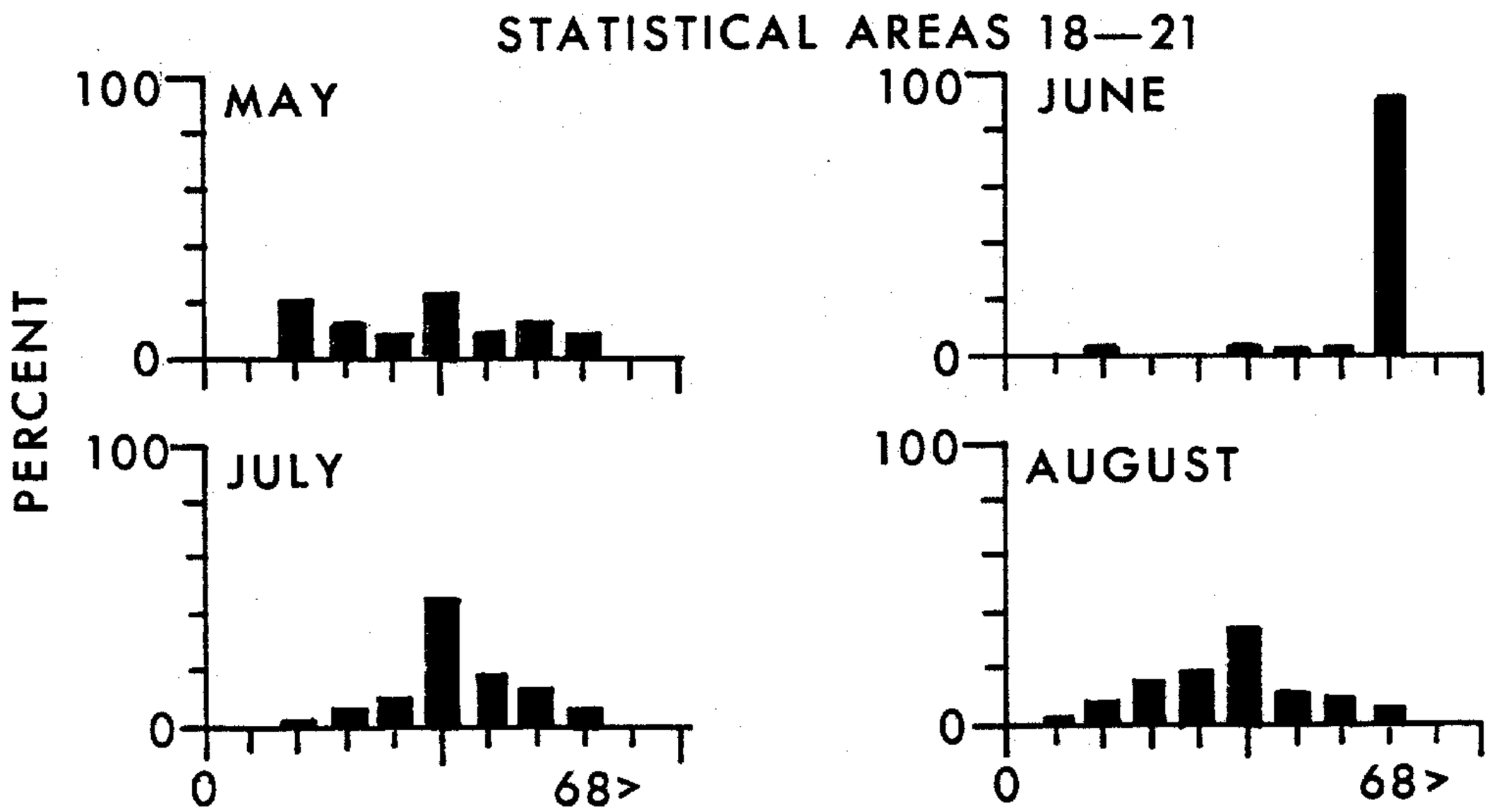


Figure 18. Percent size composition of brown shrimp caught in statistical subareas 18-21, May-Aug 1982.

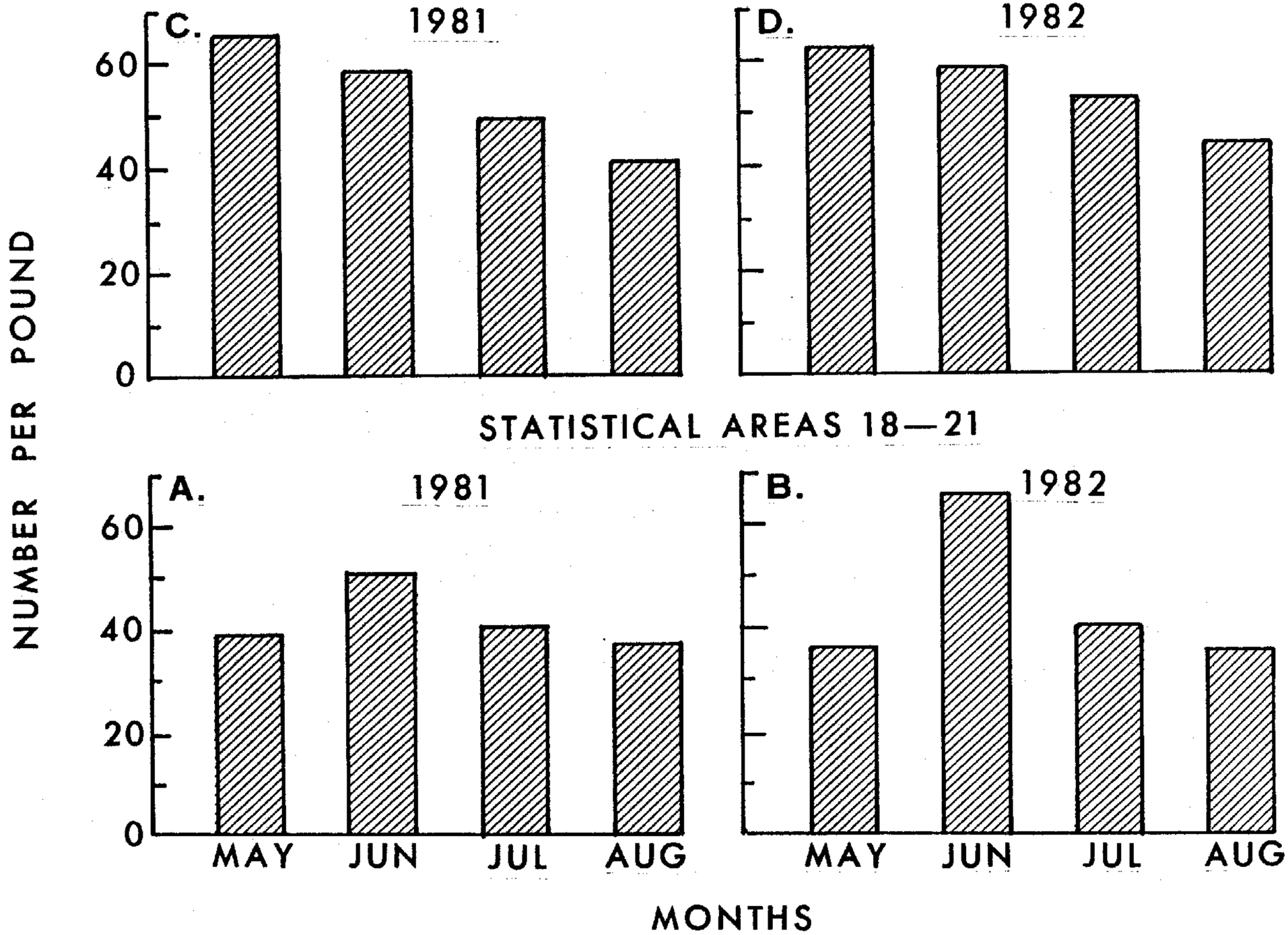


Figure 19. Average number of brown shrimp caught in a) statistical subareas 13-17 and b) statistical subareas 18-21 using size categories 15/116 count.

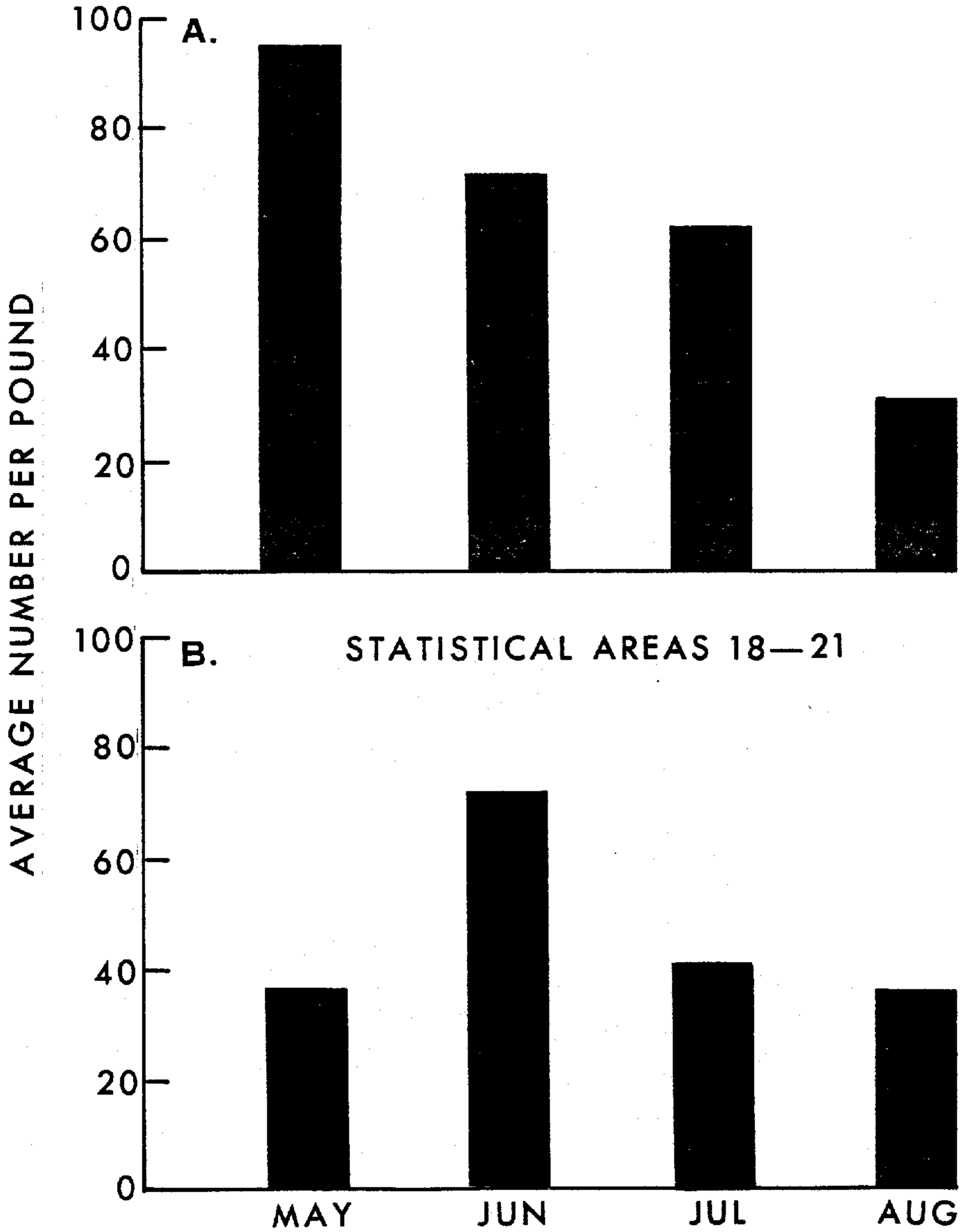


Figure 20. Average number per pound of brown shrimp caught in a) statistical subareas 18-21, 1981; b) statistical subareas 18-21, 1982; c) statistical subareas 13-17, 1981 and d) statistical subareas 13-17, 1982.

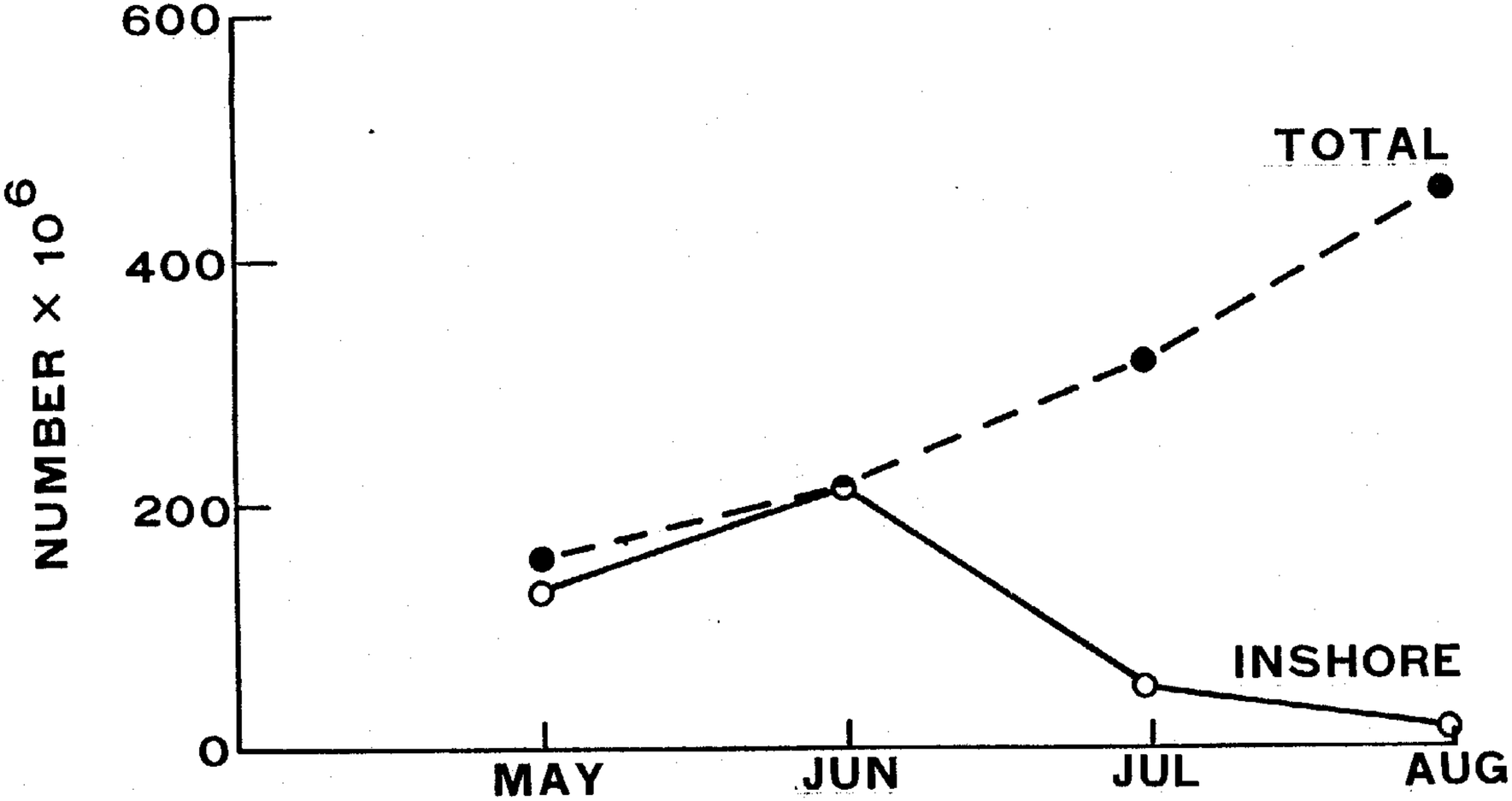


Figure 22. Number of brown shrimp caught in Texas inshore and offshore waters in 1982.

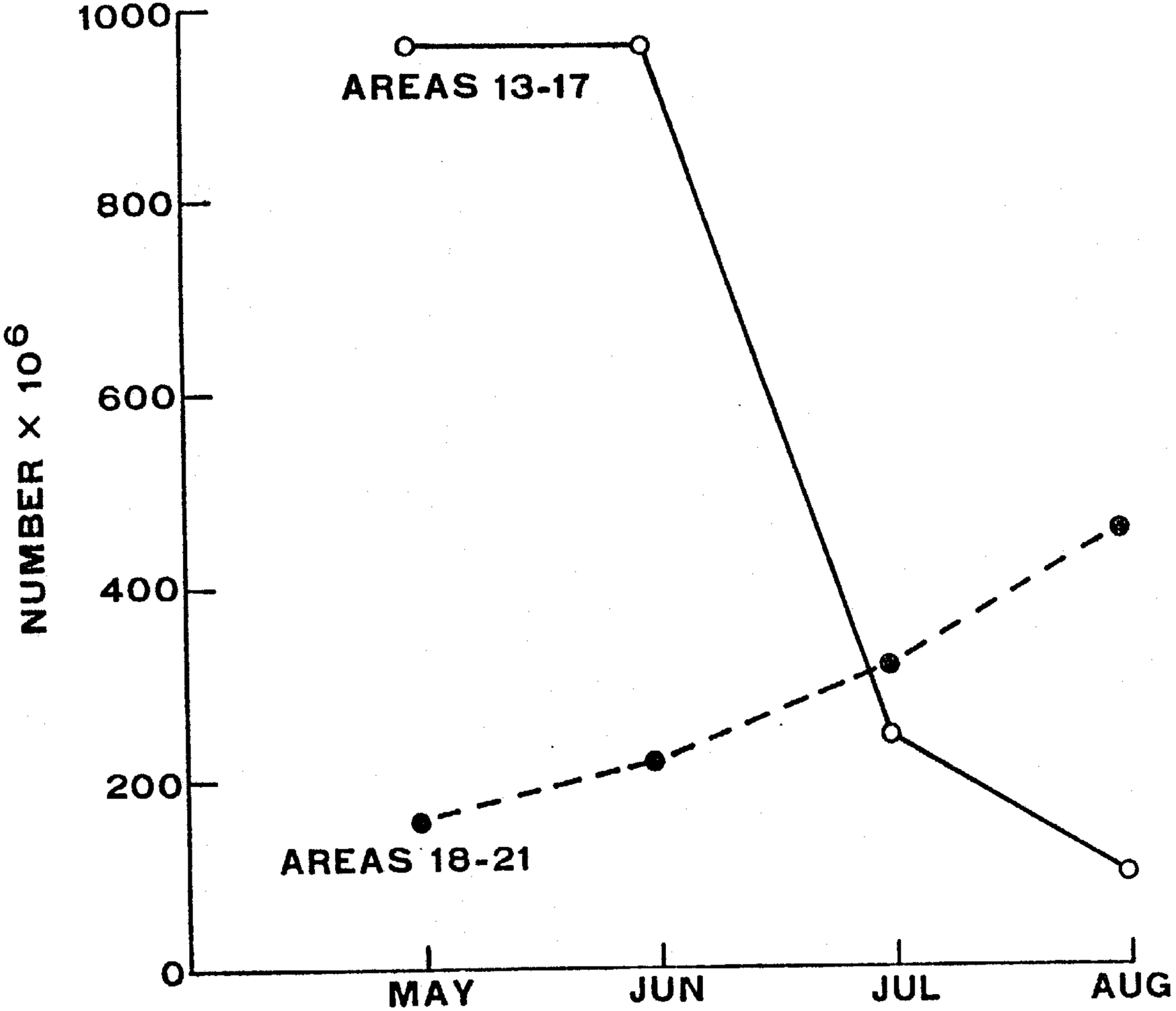


Figure 23. Number of brown shrimp caught in statistical subareas 13-17 and 18-21.